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PHARMACOGNOSY OF AYURVEDIC DRUGS

OF

TRAVANCORE-COCHIN

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Series I

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CENTRAL RESEARCH INSTITUTE

TRIVANDRUM

1951

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PREFACE

In the Ayurvedic system of medicine, as it is practised today, there is considerable variation in the identity of the various source plants of the individual drugs selected for use. Even in the original Ayurvedic texts a single source-plant in almost all cases is referred to by several names which indicate some particular characteristic of the drug or source plant, and some of these synonyms are applied to other plants as well, thus leaving the selection of the correct plant dependant upon the ingenuity, learning or common sense of the practitioners and also upon the general practice in vogue. In the absence of any continuous original research about the medicinal virtues of the source plants, and in the multiplication of texts which were only the permutations of previously published prescriptions, or prescriptions in vogue at the time of their publications, the pharmacological side of the ancient materia medica was lost sight of or imperfectly understood as mere theory divested of any practical utility, and this gradually led to confusion in practice. In an appreciably large, number of cases botanically different plants have now come to be used for the same Ayurvedic drug, in different places, and sometimes even in the same locality some different plant, more easily and cheaply available is used in the place of and even in addition to the correct plant prescribed, though there is no sanction or authority for its use. These variants and substitutes adopted by practitioners are sometimes different species of the same genus or they may belong to different families or even to different classes – one being a monocot and the other a dicot or gymnosperm. Another factor which has added considerably to the prevailing confusion is that there is no consistency even in the use of the vernacular names of a plant – different localities having different names of these plants and the same vernacular name being applied to more than one plant, thus making it difficult for anyone to get at the correct plant with the help of thes names. Striking differences are also noticed in the selection of officinae part and its mode of use, and the existence of such differences seems to have been hardly recognised.

In these circumstances it is necessary in the first place to correlate scientifically a particular Ayurvedic drug with its proper botanical source. No serious attempt seems to have been made in this direction, nor has any

scientific and authoritative list been published of all the source plants of the various drugs, sanctioned by Ayurveda, and used in various parts of the country. The resulting confusion about the correct identity of the source plant is to a great extent responsible for the somewhat stagnant state of Ayurveda at present. This condition has also been partly the result of the transmission of informations from one generation to another, each generation believing the practice in vogue in a particular locality at the time to be the correct one. Any attempt to standardise thesource plants for the whole of India is bound to be beset with many difficulties. A number of Ayurvedic works have been published from time to time, but there seems to have been no serious effort along this line. Most of these works are compilations of matter taken from earlier publications on the subject and deal mainly with the medicinal properties of a drug with out any proper description of the drug or of the correct source plant. One or more of the earlier works, however, attempt some sort of descriptive hints in verse form in Sanskrit; but these hints are very vagueor too general to be of real service in the identification of the source plant. In some of the more recent works, however,a list of names in the various Indian languages or those used in differentregions have beengiven, but these too do not seem entirely reliable or helpful in most cases. Mostly these names are based on indirect and second-hand information, or copied from previous works, and due to want of proper scrutiny and verification mistakes are repeated, or there is difference in the names noted. The books published in the nineteenth century on the subject by Indian and European students – the authoritative Pharmacographias and books on Indian Materia Medica –mark an advance They give the scientific names of the plants, thus making their identification easier, but they too seem to have depended in a great measure upon the more important of the earlier publications for information. No attempt at correlating a particular medicinal plant with the specified Ayurvedic drug is attempted in most cases, and where such an attempt has been made, more than one plant is often considered as indicated by the Sanskrit synonyms applied to one drug, thus increasing the confusion that already exists

There is only one way out of this confusion, and that is a full pharmacognostic account of each drug, giving details of external morphology, histology and chemical composition, and also fixing the identity of the source plant. In the absence of any such account with the information as at present available, it is not possible to differentiate any spurious specimen from the genuine one. For achieving real progress in Ayurveda, proper identification

of all the source plants, and a thorough study of their appearance and properties is essential, and further research can be possible only after this basic work has been done. The present work **"The Pharmacognosy of the Ayurvedic drugs of Vegetable Origin with special reference to Travancore-Cochin"** has been undertaken mainly with this object in view

A work of this kind attempted probably for the first time cannot be expected to be exhaustive or comprehensive; as it is not possible to include all the more important of the alternative source plants of each drug in use in all parts of India. Nor is it possible to say definitely which of the alternative plants are the correct ones, for it is only after full chemical analysis and the necessary pharmacological tests according to Ayurvedic principles, that any definite conclusion can be arrived at. The book has only a more limited scope, and since Travancore-Cochin is one of the most important regions where the Ayurvedic system is centuries old in practice, the source plants and their officinal parts as used in this State have been taken for detailed investigation and study. The botanical identity of the source plant in use is fixed and notes compiled regarding its distribution in India, its habitat, habit and external morphology; along with suitable sketches for purposes of correct identification. The morphological and anatomical details of the officinal part or parts have been studied in detail and described and illustrative diagrams have been given. Natural colour illustrations of the plant with special emphasis on the officinal part are also given in most cases. The descriptive accounts of the drugs and their properties as given in the Ayurvedic texts have also been taken into consideration, in this investigation and included in the pharmacognostic account of each drug In cases where the source plant in use here differs from those mentioned in texts or those in popular use in other places, mention has been made of the more important of such plants and such of them as belong to the latter class, and are available in Travancore-Cochin, have also been described on the above lines. The chemical constituents of the drugs, especially where the source plants differ, have also been worked out to facilitate a comparative study. To ensure correct identification a complete technical description of the plant has been given in each case. No attempt has been made, however, to give an exhaustive list of the names in the different Indian languages or local names since they are not always reliable and might therefore lead to confusion. Substitutes or adulterants have also been dealt with, though briefly and differential diagnosis given to distinguish the officinal part.

History of the Scheme

The work on the pharmacognosy of Ayurvedic drugs of vegetable origin with special reference to Travancore-Cochin was started by the Travancore University in January 194 under the administrative control of the Director of Research and the supervision of Dr. T. K. Koshy, the then Professor of Botany, in the Botany Department of the University College at the suggestion of Dr. L. A. Ravi Varma who was at the time the Honorary Director of Ayurveda. A preliminary list of about 260 Ayurvedic durgs to be worked out was prepared by Dr L. A. Ravi Varma with critical suggestions on each drug. I was deputed as full-time Special Officer to assist in the preparation of the work. The whole scheme was to be worked out by a technical, editorial and investigation committee consisting of Dr L. A. RaviVarma, Dr. T. K. Koshy and myself. On the promotion of Dr. T. K. Koshy as Director of Public Instruction, and the retirement of Dr. L. A RaviVarma from the post of the Hon. Director of Ayurveda, the scheme was taken over by the then Director of Research Dr. C. C. John under his direct control, and an advisory body of the following persons was appointed by the University.

The Director of Research,
The Director of Indian Medicines,
Vaidyasastranipuna Dr. L. A. Ravi Varma,
The Professor of Applied Chemistry,
The Professor of Botany,
The Director of Government Gardens,
The Conservator of Forests and
The Special Officer for Pharmacognosy.

The entire basic part of the work consisting of the investigation collection and identification, of the source plant or plants, and the preparation of the necessary descriptions and sketches and supervision of the collection and supply of material for chemical investigation is attended to by me as the Pharmacognosy Officer in charge. The chemical investigation of the samplessupplied is carriedout inthe Applied Chemistry Department of the Central Research Institute' under the direction of Dr. P. V. Nair Professor of Applied Chemistry, and the compilation of the Ayurvedic notes supervised by Sr M. N. Kesava Pillai, the Director of Indian Medicines.

No special criterion or order is now followed in the selection of the drugs to be investigated. As a good number of the source plants coming

under the scheme are indigenous to Travancore-Cochin, or otherwise available, the plants are collected as need arises.

At present there is no regular cultivation of any of these drug plants in Travancore. They are collected from wherever they are available. Only those anatomical details which are of importance in identification have been given. In a work of this kind-probably the first attempt of its kind in India- carried out under very limited facilities, it has been possible now to give only the more important aspects of each drug and omissions and even mistakes are likely to have occurred, though all possible care has been taken to keep out such mistakes. Helpful suggestions about the work and the conclusions arrived at in this work will be gratefully received

My grateful thanks are due to Dr. T. K. Koshy and Dr. L. A. Ravi Varma who were largely responsible for starting this work and who rendered great help in its initial stages. I am also indebted to Dr. C. C. John for his continued interest in the work and for very considerable help in the preparation of the manuscript. My thanks are also due to Dr. P. V. Nair, Professor of Applied Chemistry and Sri M N. Kesava pillai, Director of Indian Medicines, for their assistance. Lastly I wish to express my high appreciation of the skilful service rendered by the artists Mr. Padmanabha Aiyer and Mr. Sreedharan Nair.

Trivandrum.
July, 1951.

K. NARAYANA AIYER M. A.,
Pharmacognosy Special officer.

TABLE OF TRANSLITERATION

Sans.	Eng.		Sans.	Eng.	
अ	A	a	ट्	Ṭ	ṭ
आ	Ā	ā	ठ्	Ṭ H	ṭh
इ	I	i	ड्	Ḍ	ḍ
ई	Ī	ī	ढ्	Ḍ H	ḍh
उ	U	u	ण्	Ṇ	ṇ
ऊ	Ū	ū	त्	T	t
ऋ	Ṛ	ṛ	थ्	TH	th
ए	E	e	द्	D	d
ओ	O	o	ध्	D H	dh
ऐ	AI	ai	न्	N	n
औ	AU	au	प्	P	p
०	Ṁ	ṁ	फ्	PH	ph
००	Ḥ	ḥ	ब्	B	b
क्	K	k	भ्	BH	bh
ख्	KH	kh	म्	M	m
ग्	G	g	य्	Y	y
घ्	GH	gh	र्	R	r
ङ्	Ṅ	ṅ	ल्	L	l
च्	C	c	व्	V	v
छ्	CH	ch	श्	S'	s'
ज्	J	j	ष्	Ṣ	ṣ
झ्	JH	jh	स्	S	s
ञ्	Ñ	ñ	ह्	H	h

LIST OF ABBREVIATION

bf. bast fibre.
bt. bast.
cam. cambium.
ck. cork.
co. cortex.
crm. ceratenchyma.
lx.t. latex tube.
m. medulla or pith.
mr. / mdr. } medullary ray.
ph. phloem.
ph- Primary phloem.
phd phelloderm.
phf- phloem fibre.
pn. phellogen.
rn. rind.
s. starch.
scl. sclerenchyma.
stcl. stone cell.
svt. sieve tube.
v. vessel.
wd. wood.
wf. wood fibre.
xp. xylem parenchyma.
xy. xylem.

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PĀṬHĀ

Source Plant in Travancore

Cyclea Peltata Diels — and other species, belonging to Menispermaceae.

Sanskrit Text:

Descriptive factors:

"Pāthā'mbastha viddhakarni sthapani s'reyasi rasā
ekāsthila pāpaceli prācinā vanatiktakā"

(S'āligrāma nighaṇṭu)

"Pātha'mbasthā proktā prācinā pāpacelikā ceti
varātiktā ca sutiktā vrkatiktā pāthikā vrki nāmnā
varkāhvā vrki ceti varā tikta cā tiktikā
sthāpani coddhati ceti s'abdaih paryāvāvācakaih"

(Abhidhānamañjari)

'Ambastha', 'pāpacelika', 'sthāpani', ekasthila' etc. Point to the highly mucilaginous succus which becomes almost solid in a short while.

'viddhakarni' refers to the peltate leaf; and 'tiktā' 'varā tiktā' etc. to its bitter taste.

Ayurvedic properties:

"Pāthosna katukā tiktā* vatāslesmahari laghu"

(Bhāva prakāsa)

It promotes metabolism, is pungent or aromatic, is a bitter, is sedative to the nervous system and it also controls mucous secretions.

Uses.

"Hanti sula-jvara-cchardi-kustha tısāra-hrdrujah
dāha-kandū-visa-s'vāsa krmi-gulma gara vranān"

(Bhāva prakās'a)

It is useful in colicky pains in the stomach, fevers, vomitting, skin conditions, diarrhoea, cardiac pains, burning feeling, pruritus, poisons

---

tiksna is another reading.

breathing difficulties, worms, colicks, internal tumours(?) ('gulma,) colicks, in poisons taken internally ('gara') and ulcers. Rajanighantu speaks of this as useful in setting fractures. "Bhagnasandhanakrt" and Astangahrdaya include piles also as a condition in which the drug is useful. (It is largely used in Kerala as an internal remedy in inflamed piles).

The root is the part mostly used in Kerala though the succus of the leaves is occasionally used as an anodyne in inflamations such as abscesses.

Two types are contemplated in texts: Pāthā and Laghu-pāthā

N.B. Kritikar and Basu equate Laghupatha with *Cissampelos pareira* L. and Pāthā with *Stephania hernāndifolia*, Wālp. Khōry and Katrak equate Pāthā with *Cissampelos pareira*.

Of these, *Stephania hernandifolia*, is fairly common in the Wester Ghats from 1,500 to 2,500 feet: it is however doubtful whether it is medicinally used in Kerala as source of Patha. *Cissampelos pareira*- known a 'Malatanni, in malayalam- is accepted as a medicinal plant in Kerala, but not as Pāthā.

There is no reference to *Cyclea peltata* as a medicinal plant in published literature.

CYCLEA PELTATA, Diels.

Syn. C. Burmanni.

(Menispermaceae)

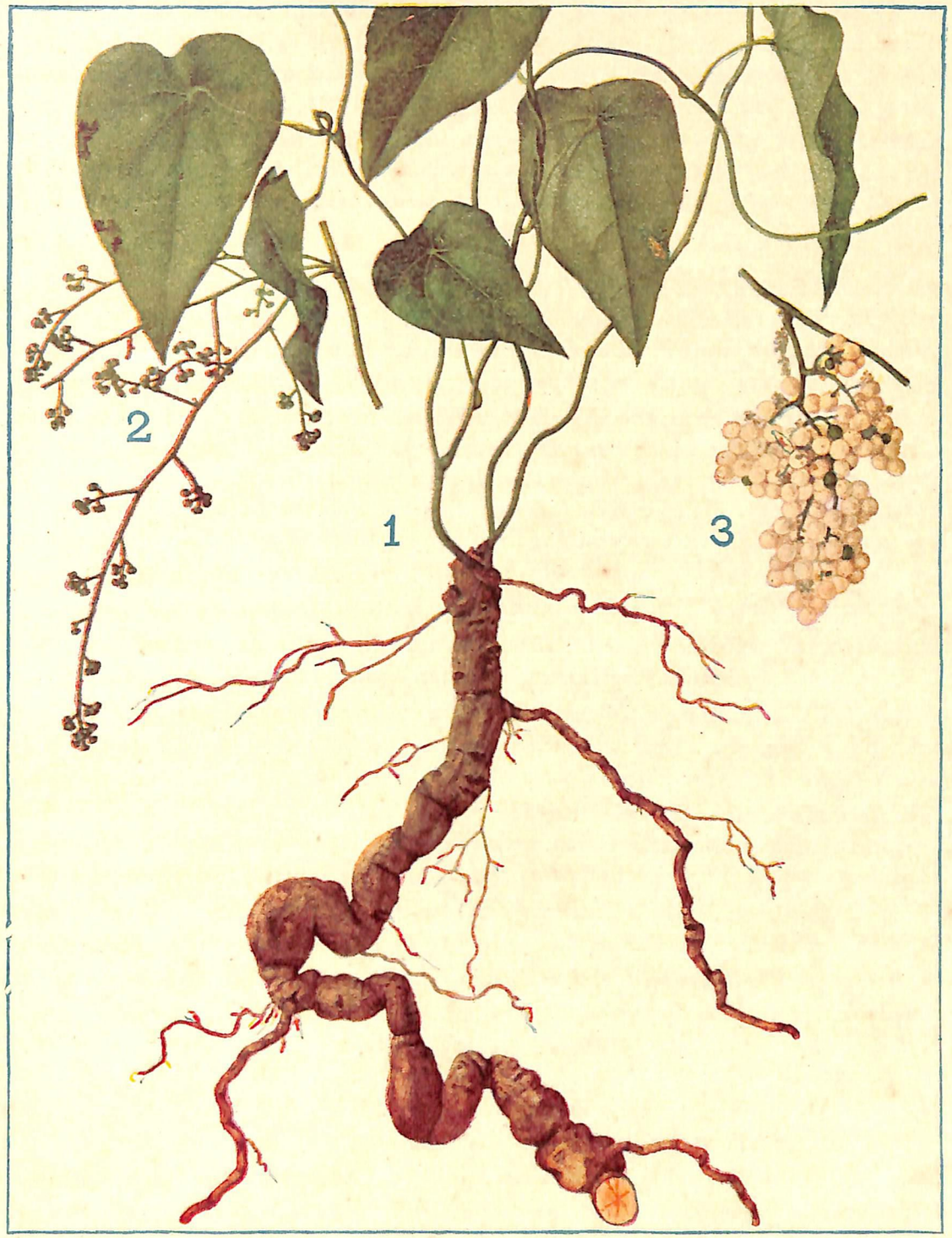
Tamil	Pāṭai; Pāṭattāli
Malayalam	Pīta; Pāṭakizhangu
Hindi	Pāthā: Pādhā.

Distribution and Habitat

Western Ghats from S. Canara to Tinnevelly, Hills of Mysore and N. Arcot

The plant is very common in the West Coast of India where it grows wild in almost all uncultivated and out of the way places, mainly under mesophytic conditions, from sea-level to about 3,000 feet.

Cyclea peltata is a much branched straggling, glabrescent or slightly hairy twiner, with a long perennial underground tuberous root and dark green foliage almost completely covering the support. The stems and branches which twine anticlockwise may reach maximum thickness of about a



I. Cyclea peltata, Diels

1. Plant showing tuberous root (officinal part)
2. Staminate inflorescence
3. Fruit cluster

quarter of an inch They are strong cord-like, dark green to ash-grey with ten to fifteen or more faint spiral longitudinal striations or ridges and are normally devoid of prominent nodes, knots or lenticel eruptions. The surface, especially along the edges of the ridges or ribs is sparsely covered with short stiff slightly curved hairs. The degree of hairiness is a variable factor, depending on the nature of the habitat, especially rainfall. Periodically during favourable seasons the plant puts forth fresh shoots from the stumps or basal portions of older stems.

External morphology

Leavers simple, alternate, exstipulate, peltate, long-deltoid coriaceous, entire or sub-repand, palmately veined, truncate to slightly cordate at base, and acute mucronate at apex; upper surface shiny, and dark green with a sprinkling of short stiff or bristly whitish hairs over the veins: lower surface paler, softly pubescent, or velvety and covered with simple, slender, minute hairs. There are five to seven prominent ribs and three to five shorter, less prominent ones, all starting from a common point near the leaf-base. The two lateral veins on each side of the midrib arching upwards terminate at the margin about two thirds the distance from the base. The petiole is articulated to a short nodal prominence. It is usually less than half the length of the leaf and markedly long-pulvinate at base and distal end, the former being usually partially twisted.

Flowers unisexual, small greenish and inconspicuous. The male and female flowers occur on different plants and are arranged in many flowered upra-axillary branched panicles often arising from older parts of stems or branches: **staminate inflorescence** usually longer than the ea ves with the flowers lax, **Pistillate inflorescence** shorter than the leaves and densely crowded with flowers. **Staminate flowers: sepals** 4 to 6 connate, forming a greenish, hairy 4 to 5 lobed broadly urceolate structure with valvate lobes or teeth; petals connate, in the form of a semi-fleshy, saucer shaped, lobed structure, from the centre of which arises the stamina column, anther 4 to 6 equal in number to calyx lobes, arranged horizontally on the rim of the flattened disc-like top of the staminall column and dehiscing transversely. **The pistilliate flower** has an anterior bract. Its perianth consists of two laterally placed slightly fleshy, broadly ovate to orbicular structures. Ovary single unoqually dilated on one side at base. Style is short and ends in three radiating stigmatic branches.

Fruits. small, ovoid, drupaceous berries less than or about the size of a pepper, creamy white when ripe, and aggregated in attractive grape-like

bunches, two to six inches long. Style-scar sub-basal; endocarp horseshoe shaped and dorsally tubercled. Seeds curved. with slender semi-terete closely appressed cotyledons.

Officinal part:

The main officinal part of the plant is its underground tuberous root leaves are also used for external applications in certain conditions.

Description of root

The primary root which develops into a tuber, is fairly long, cylindrical, unbranched and uniformly thick and straight when young, but becomes crooked or irregularly bent as it gets older. The tubers vary in size from six inches to two and a half feet or more in length and from a quarter to about two inches in thickness.

The outer skin, is fairly smooth, and very thin usually of a slate-grey or light brown tint and without prominent lenticels. In fresh roots it is so soft that it could be easily scraped, but being very thin could not be easily peeled nor would it peel off by itself. It is generally devoid of prominent fissures, furrows or corrugations though in older and stouter roots thin, short, vertical slits or cracks are often noticeable. These however do not tend to make the surface rough.

Large, well developed tubers generally have transverse constrictions and curves at frequent intervals. In such roots a few prominent lenticels may occasionally be found in the form of ridge-like, wavy, transverse slits, fringed with corky tissue. Lateral roots are very few, and are usually found towards the lower portion of the primary root. In addition to these a few wiry or string-like rootlets may be occasionally present.

The greater part of the tuber is fairly fleshy or succulent and starchy. The comparatively small woody portion consists of a few vascular bundle strips, which exhibit a characteristic form and arrangement in transverse and tangential sections. On removing the entire 'bark', including all parts outside the xylem, the vascular bundles appear as an anastomosing array of slightly depressed brownish strips on the exposed surface

The fresh roots break easily at the constrictions with a short fracture. On drying the tubers shrivel up considerably. In this condition the skin adheres so firmly to the surface that it cannot be easily scraped. The dried roots also break with a short fracture. Both the fresh and dried roots have a bitter taste, but no characteristic smell.

Histology:

A transverse section of the root is more or less circular in outline and starchy white in colour. It shows a broad central core of stele, (the central cylinder) filling the greater part of the area, surrounded by a comparatively narrow ring of cortex, and a thin brownish strip of skin. The cortex and the skin together form only less than one tenth the thickness of a fresh tuber. The central cylinder has three to six, or rarely a few more, narrow wedge-shaped xylem strips, the apices of two or three of which meet at the centre. These wedges of xylem alternate with a corresponding number of very broad masses of soft medullary parenchyma. During secondary growth there is no proportionate increase in the width of the xylem strips corresponding to increase in the thickness of the roots. In older roots, however, in addition to these there are also secondary xylem strips towards the periphery of the medullary parenchyma. In tangential sections the wood tissue has a reticulated appearance with meshes of varying sizes but without actual fusion between the adjoining strands There is no pith in the centre.

The outer skin (cork tissue) consists of rows of rectangular cells, of which the peripheral six to eight rows form a thin outer rind of compressed or collapsed cells, with dark brown walls. The inner part of the skin consists of four to six or more rows of very regularly arranged rectangular slightly tangentially extended cells with thin pale brownish or yellowish-brown walls. **The phellogen** or **cork cambium** is well developed and formed of one or two rows of cells. **The phelloderm** consists of three to five rows of regularly arranged tangentially extended narrow rectangular or oblong cells.

Inner to the cortex and forming the outer boundary of the stele is a narrow, but conspicuous, annular, uninterrupted strip of two or three rows of cubical to elliptic-oblong stone cells of varying size with very thick pitted walls.

Stele: the bulk tissue of the stele is medullary parenchyma which is composed of broad rectangular thin walled radially extended cells thickly packed with starch grains. The wedges of woody tissue which are embedded in the meduallary parenchyama are bounded at their peripheral ends by semicircular masses of phloem which almost abut on the ring of stone cells The older elements or the bast or the primary phloem issues are distinguishable as light yellowish crescentic arches of compressed tissue just toutside the sesemicircular masses. Newly formed phloem is composed of he usual types of elements but without any associated mechanical cells

The cells forming the distal portion of the masses of medullary parenchyma between successive phloem elements are tangentially extended.

Each radial strip of wood tissue is composed of a number of scattered xylem vessels of varying sizes, surrounded by masses of small regulary arranged cubical, rectangular, or polygonal thickwalled cells. Occasionally each strip may also contain thin walled parenchyma in between these masses. In sections of young tubers a very limited number of radiating strips of xylem composed solely of parenchyma scarcely distinguishable from the surrounding medullary tisssue is found, in addition to the more prominent woody rays. Their cells are rectangular to polygonal, thin walled, radially elongate and smaller than the cells of the medullary rays. Some of the supplementary xylem strips found in older tubers are continuations of these strands. The cavities of some of the large vessels are occluded with tyloses. A few stone cells are sometimes found towards the centre.

Distinguishing features of the root.

A. *Morphological:*

1. The root is slate grey in colour, normally unbranched cylindrical, fairly thick, irregularly bent, and some what torulose with the transverse constrictions at frequent intervals. Fresh roots have somewhat fleshy turgid consistency. The surface is smooth and non-lenticellate in most cases.

2. The skin is very thin, soft and easily scrapable but non-peelable when fresh. In dry roots it adheres firmly.

3. The cut surface is dull white in fresh roots but appears greyish with a smooth waxy lustre in dried roots.

4. The roots break easily at the constrictions with a short fracture.

5. A central woody strand is absent.

6. When the root is cut tangentially with a sharp knife the thin narrow strips of wood in the cut surface show a reticulated appearance.

B. *Anatomica.*

1. Transverse section of the fresh tuber is regular and circular or rarely oblong.

2. The cork zone which is seen as a thin slaty grey line in transverse section is formed of a few rows of thin-walled tangentially elongate empty cells.

3. A conspicuous ring of sclereids composed of two or more rows of cells is present near the periphery. This ring separates a very narrow cortical region from a comparatively very wide central cylinder.

4. The stele forms the bulk of the root. There are only a very limited number of xylem or wood strips. These appear in transverse sections as thin brownish wedges meeting at the centre. The medullary rays are in the form of wide triangular masses separating the adjacent xylem strips. In the case of older roots there may be a few more peripherally placed xylem strips which cut up the broad medullary bands into a series of peripheral segments.

5. The medullary parenchyma is composed of large thin walled cells fully loaded with starch grains.

6. There is no continuous zone of bast. Phloem elements are found only outside the distal ends of the xylem strips. Elements of primary phloem in a compressed condition are seen in crescentic patches of a light yellowish colour outside recently formed bast elements.

7. A central core of pith is absent.

C. Taste and odour

Fresh as well as dried tubers are bitter to taste.

Chemical constituents.

The tubers contain total alkaloid (0·51%) fixed oil (8·0%) Quercitol and traces of a colouring matter.

The alkaloids are isoquinoline derivatives and seem to be related to bebeerine. They have the molecular formulae $C_{18}H_{21}O_3N$ and $C_{21}H_{23}O_4N$.

The oil has the following physical and chemical constants.

Specific gravity (30°c	0·8903
Acid value	15.25
Saponification value	16[illegible]3
Iodine value	79·8
Acetyl value	13·4
Non-saponifiables	5·9%
Total acids	88·4%

Stearic, palmitic and oleic acids are found in the mixture of fatty acids liberated from the oil.

CISSAMPELOS PAREIRA Linn*

(Menispermaceae)

Malayalam .... Malatānni

Distribution and Habitat.

A fairly common plant of the warm dry mesophytic regions of tropical and sub-tropical India, from sea-level to an elevation of about 5,000 feet but not found in very arid regions. Its range extends from the Sub-Himalayan tract, Sind and the Indus Basin southwards to Travancore and Ceylon.

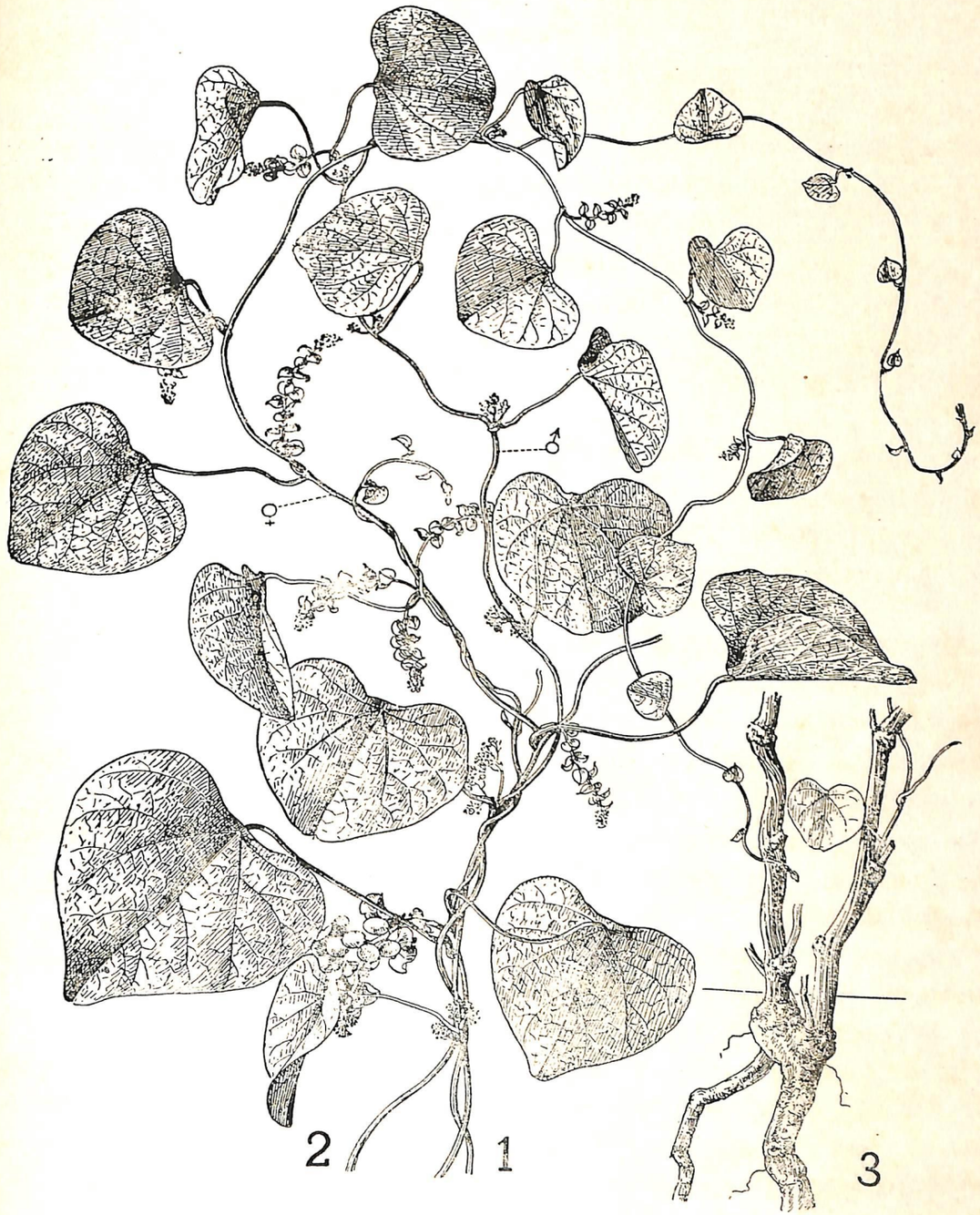
Cissampelos pareira Linn. is an extensively spreading glabrous to softly grey pubescent perennial twiner, with stout nodose stems upto half an inch in thickness, from which arise seasonally or periodically a number of strong, woody, terete, spirally striated, whip-cord-like branches, covered with light brownish or greenish-brown skin, bearing alternate, long stalked, membraneous to somewhat leathery orbicular reniform leaves and small inconspicuous greenish-yellow flowers.

The colour, texture and degree of pubescence of the shoots are closely related to the nature of the habitat. In plants growing in the mesophytic plains the leaves are glabrous, membraneous and bright green, whereas in those from dry or elevated regions, the leaves are thicker, softly pubescent or even villous and greyish-green. The stems and branches of the tender shoots are often densely downy and pale greyish, very rarely glabrous and glossy green. The older stems and branches are generally glabrescent with ash-coloured or light brown wrinkled bark and thickened nodes.

External Morpho'ogy

Leaves simple alternate, exstipulate sub-peltate usually somewhat broader than long, orbicular-reniformato reniform-cordate, thin, greenish-entire or occasionally ciliate and slightly repand; emarginate-mucronate (rarely sub-acute); truncate or slightly cordate at base, palmately five to seven nerved, and often pubescent on both surfaces when young. Older leaves glabrous or with few scattered hairs. Petiole as long as the leaf or slightly longer slender, flexuose, pulvinate at base and apex with the basal pulvinus slightly twisted and sub-peltately attached to base of blade just within the margin.

**Cissampelos pareira* is the plant mentioned as the Botanical source of Pāthā in a number of books.



II *Cissampelos pareira*, Linn.

1. Pistillate plant 2. Staminate plant 3. Basal portion showing root

Flowers: unisexual small and inconspicuous; the male and female occuring on different plants. **The staminate inflorescence** is a cymose panicle with short filiform, divaricate, dichotomous branches, carrying solitary or fasciculate flowers articulated just below the calyx. **Bracts** small and subulate. **Staminate flowers**: **Sepals** four, spreading spatulate-ovate, hairy outside, entire or erose; **petals** united to from a shallow four lobed cup-shaped membraneous structure shorter than the calyx; **Stamens** four, the filaments cohering to from a very short central column with the anthers connate around its flattened top forming a synandrium and dehiscing transversely or horizontally, **The pistillate inflorescence** is a slender axillary raceme with three to six flowers crowded in fascicles or umbels in the axils of small but prominent orbicular or ovate foliaceous usually persistent bracts. **Pistillate flowers** with two sepaloid structures, of which the outer structure is oval, and externally hairy, while the inner one is similar but slightly smaller and greenish white. **Pistil** formed of one ovoid densely silky carpel which is gibbous on the side opposite the petal; style short and terminates in a trifid spreading stigma.

The fruit is a small, compressed, ovoid or sub-globose, fleshy drupe about the size of a pepper, brick-red when ripe, and attractively placed in the axil of the persistent bract. **Epicarp** slightly fleshy, thin and pilose; endocarp compressed, horse-shoe shaped, transversely ridged and furrowed on the edge and with concave sides; seed strongly curved with very thin testa and a slender terete embryo.

Officinal part.

The officinal part of the plant is the primary root.

Description of root.

The main root is perennial, deep growing and seldom branched. Generally it is long, narrow, cylindrical to fusiform, more or less tortuose and slightly hard and woody. But variations ranging form thin or even stringy crooked woody types almost black in colour to fairly thick, tuberous, brownish forms are noticeable. The portions of the root found close to the base of the shoot system, which is the most easily obtainable part, is usually narrow and woody. The deeper parts are generally more fleshy and tuberous and often attain much larger size.

In the dried root, the skin or outer bark is brownish to dark grey, thin corky and slightly friable. The corky layer is fairly thick when compared

with the total thickness of the root. The surface is usually covered with numerous minute pits and long, wavy vertical branched fissures or cracks, suggesstive of a worm eaten or corroded appearance. Older and thicker tubers are longitudinally ridged or wrinkled and have a greyish brown surface skin with deep short transverse cracks at distant intervals.

Fresh roots do not have any odour, but dried samples when bruised emit a faint aroma. Both fresh and dry roots are very bitter, though the latter is feebly sweetish at first. The roots are some what starchy but not usually succulent. They dry up quickly but do not shrink much in storage because of the presence of a thick corky outer bark and the larger sproportion of wood tissue.

Histology

The anatomical structure of the root of *Cissampelos* is more or less similar to that of *Cyclea*. In transverse sections the outline is often wavy or ridged, the ridges corresponding in number to the wedge like masses of wood. Eight or more radiating highly porous vascular bundle strips, separated by broad medullary rays are visible and these show the same structure as in *Cyclea*. The number of wood strips is however greater and they are distinctly broader than in the latter. Two to four of the larger vascular bundle strips meet at the centre. Of the smaller ones, a few extend as far as the centre some reach about half the distance from the periphery to the centre while the rest, namely the most recently formed ones are short. These cut up the medullary parenchyma into a number of narrow peripheral segments.

At the periphery there is a comparatively thick zone of cork formed of twenty or more rows of cells of which the outer rows are often compressed to form a definite corky rind. The cells are thin-walled, rectangular, tangentially elongate, and mostly empty. **Phellogen** consists of one layer of narrow elongate cells and the **Phelloderm** is a narrow zone formed of three to six rows of cells which are slightly larger than the cork cells. It does not usually contain starch grains or other inclusions. Next to it is a narrow but distinct annular zone formed of two or three or more rows of stone cells. The stone cells are of various shapes, being cubical, oval, oblong or even tangentially elongate with sides often oblique. Their walls are thick and pitted and some of them contain inclusions in the form of cubical crystals.

The stele is a very broad zone and occupies the entire area within the ring of stone cells. It consists of a number of wood strips alternating

with masses of medullary parenchyma. The cells of the medullary parenchyma are much larger than those of the xylem or phelem. They are thin-walled rectangular and radially elongated in the xylem part, but outside the wood they are tangentially extended the transition from the former to latter being gradual. The cells are fully packed with starch grains of various sizes and shapes as in *Cyclea*. the only difference being that in this species they are slightly smaller. The wedge-shaped xylem strips consist of a larger number of thick walled vessels of various sizes with pitted walls surrounded by thick-walled sclerenchyma. There is a thin strip of cambium just outside the wood and this is followed by a semicircular patch of phelem which extends very close to the ring of stone cells. Recently formed phelem elements alone are functional and retain their proper form. The older elements are in a collapsed or compressed condition and appear yellowish. One or two rows of tangentially elongated parenchymatous cells may be present between the phelem and the ring of stone cells. But no elements of mechanical tissue are associated with phloem proper. Pith is absent.

Distinguishing features of the root

A. Morphological:

1. The root is long, cylindrical, narrow, somewhat tortuose and slightly woody. Surface usually non-lenticellate and often minutely corroded and greyish brown to dark-grey in colour.
2. The skin is thin, non-peelable, corky and slightly friable.
3. The cut surface is dull white and shows a limited number of radiating strips of wood separated by softer and broader wedges of tissue.
5. The root breaks with a short fracture.

B. Anatomical.

1. The transverse section is circular, and the outline is slightly ridged.
2. The cork zone is composed of 15 to 20 or more rows of narrowly rectangular slightly thick-walled empty cells.
3. Cortical zone very narrow formed of five to ten rows of thin walled, large sized, oblong tangentially elongate cells loaded with starch grains.,

(U. G. C. Book Bank)

4. Marking the outer boundary of the stele there is an uninterrupted annular strip of two to three rows of variously shaped stone cells with hitck pitted walls.

5. The stele forms the bulk of the root. Only a limited number of narrow wedge shaped xylem strips reach the centre. Compared with *Cyclea* the wedges of wood are comparatively broader and more in number. All the cells of medullary parenchyma are large, rectangular, thin walled, radially elongate and fully packed with starch grains.

6. The bast or phloem does not form a continuous zone but occurs as patches outside the xylem wedges only.

7. There is no pith in the centre.

C. Taste and odour.

Taste bitter. The fresh roots do not have any odour, but dried roots have a faint agreeable aroma.

Chemical Constituents

The dried tubers contain total alkaloids (1·8%), starch (29·9%), ash (8·3%). There is preponderant proportion of bebeerine in the total alkaloid content. The ash contains iron, manganese, calcium and sodium in varying proportions. Total extractives; petrol ether, 2·4% ether; 3·6% alcohol 13·8%, chloroform 2·5%, acetone 7·8% and water 11·6%.

Histology of *Cyclea and Cissampelos* roots.

Fig. 1. Transverse section of *Cyclea* root. (×5)
" 2. Cut bit of *cissampelos* root.
" 3. Transverse section of *Cissampelos* root. (×8)
" 4. Medullary ray cells with starch grains.
" 5. Cut bit of *cyclea* root.
" 6. Portion of wood in *Cyclea* root with adjacent medullary ray cells.
" 7. Details of transverse section of *Cyclea* root.
" 8. Details of *Cissampelos* root.

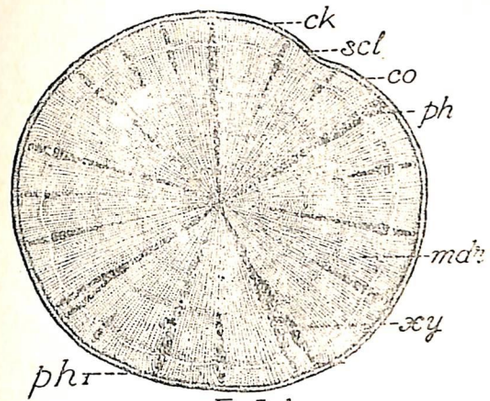


Fig 1


Fig 2

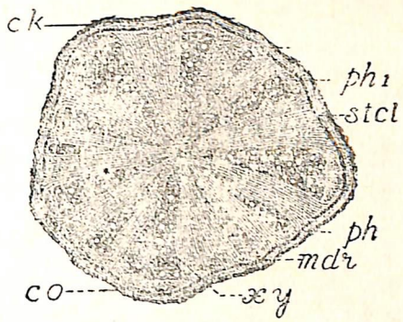


Fig 3

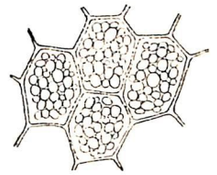


Fig 4


Fig 5

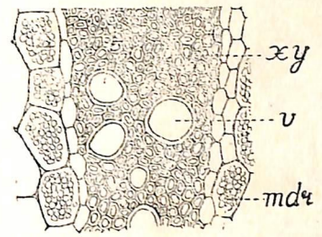
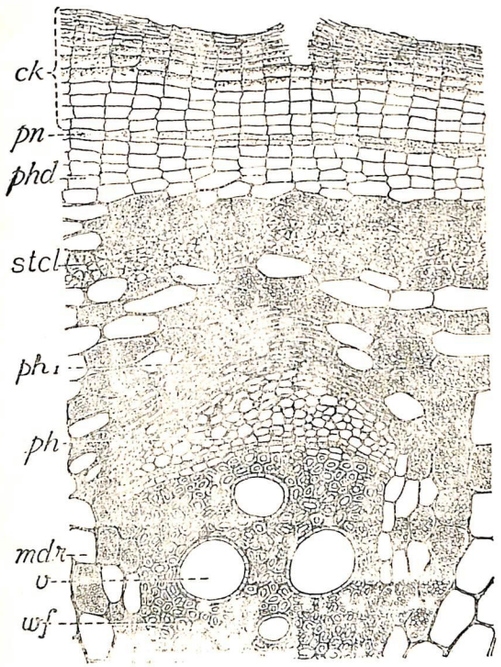


Fig. 6



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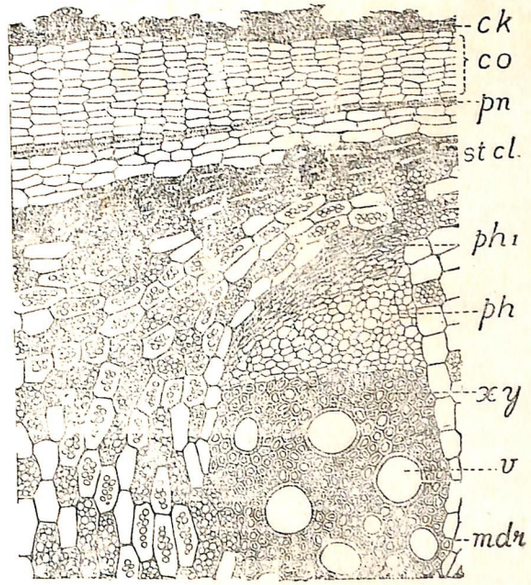


Fig. 8

S'ĀRIBĀ

Source plant

Hemidesmus indicus, R. Br. belonging to **Asclepiadaceae**

Sanskrit texts.

Descriptive factors:

"Kṛṣṇā tu s'ārivā s'yāmā gopī gopavadhūs'ca sā
Dhavaṭā s'ārivā gopā gopakan'yā krs'odarī
Sphotā s'yāmā gopavallī latasphotā ca candan'ā"

(Bhāva pr'akāsa)

The Ayurvedic texts mention of two varieties, viz. 'kṛṣṇā' or black variety and a 'dhavala' or white variety.* The terms 'kṛṣṇā' and 's'yāmā' point to the dark colour; 'Gopī', 'Gopavadhū', 'Gopā, 'Gopakan'yā, and 'Gopavallī which are applied to both varieties indicate the presence of a milky exudate; 'Can'dan'a, my point to its peculiar fragrance; 'Gopavallī, to the laticiferous vine, and 'Kṛs'odari and 'Latā to its slenderness. The term 'Anantamūla' which is also a synonym refers to its very long root.

Ayurvedic propertics and uses.

"S'āribe dve tu madhure kapha vātāsranās'ane"

(Dhānvantari nighaṇṭu)

"An'antā grāhiṇī raktapittapras'aman'i himā"

(Sāligrāma nighaṇṭu)

"S'ārivā yugalam svādau sn'igdham s'ukr'akram guruḥ
Agnimandya ruchis'vasakasa mavisanas'an'am
Doṣatr'ayāsr'aparadara jvarātisāra nās'an'am"

(Bhāva pr'akās'a)

"S'ārivā vātapittasrkṭrchar'di jvaranās'inī"

(Rājavallabha Nighaṇṭu)

"S'vetā tu s'āribā s'ītā madhurā s'ukr'alaḥ guruḥ
Snigdhā tiktā sugandhis'ca kusthakaṇḍu jvarāpahā

---

* The authors of Dhan'vantari nighaṇṭu and Rajanighaṇṭu seem to prefer the lighter coloured material Sāribānya kṛṣṇa mūla kṛṣṇa candan'a sāribā the darker variety being known by such names as krsna can'dan'a sāribā etc. In Kerala however preference is given to the darker variety. The root of *Ichnocarpus frutescens*, R Br. is considered as the alternate variety.

Dēhadaurgandhyāśgnimāndya svāsa kāśāśruci harā
Āmatridosa Visahrdraktarug pr'adarāpahā
Kaphātīsāra trddāha raktapittaharāparā vātanās'akarī prokta;

(Nighantu Ratnakara)

"Krsnā tu s'ariva s"itā vrsyā ca madhurā matā
Kaphagn'i caiva sampr'oktā gunās'cānye tu pūrvavat"

(S'aligrāmā nighantu)

Both varieties are sweet and destroys ill effects of abnormal kapha (mucus secretions etc:) vata and blood.

It is 'arresting' (stops diarrhoea) : cures haemorrhage resulting from mutual vitiation of pitta and blood and is cooling. It is also demulcent, productive of semen, heavy of digestion, cures deficient digestive power, tastelessness, difficult breathing cough, toxic conditions due to accumulation of unassimilable products of defective digestion, vitiation of the three primary factors (vata, pitta and kapha) uterine haemorrhage, fever and diarrhoea. S'ariva is also considered a bitter, as beneficial in thirst, vomitting. skin diseases, pruritus, bad smell of the body and in poisoning.

HEMIDESMUS INDICUS R. Br.

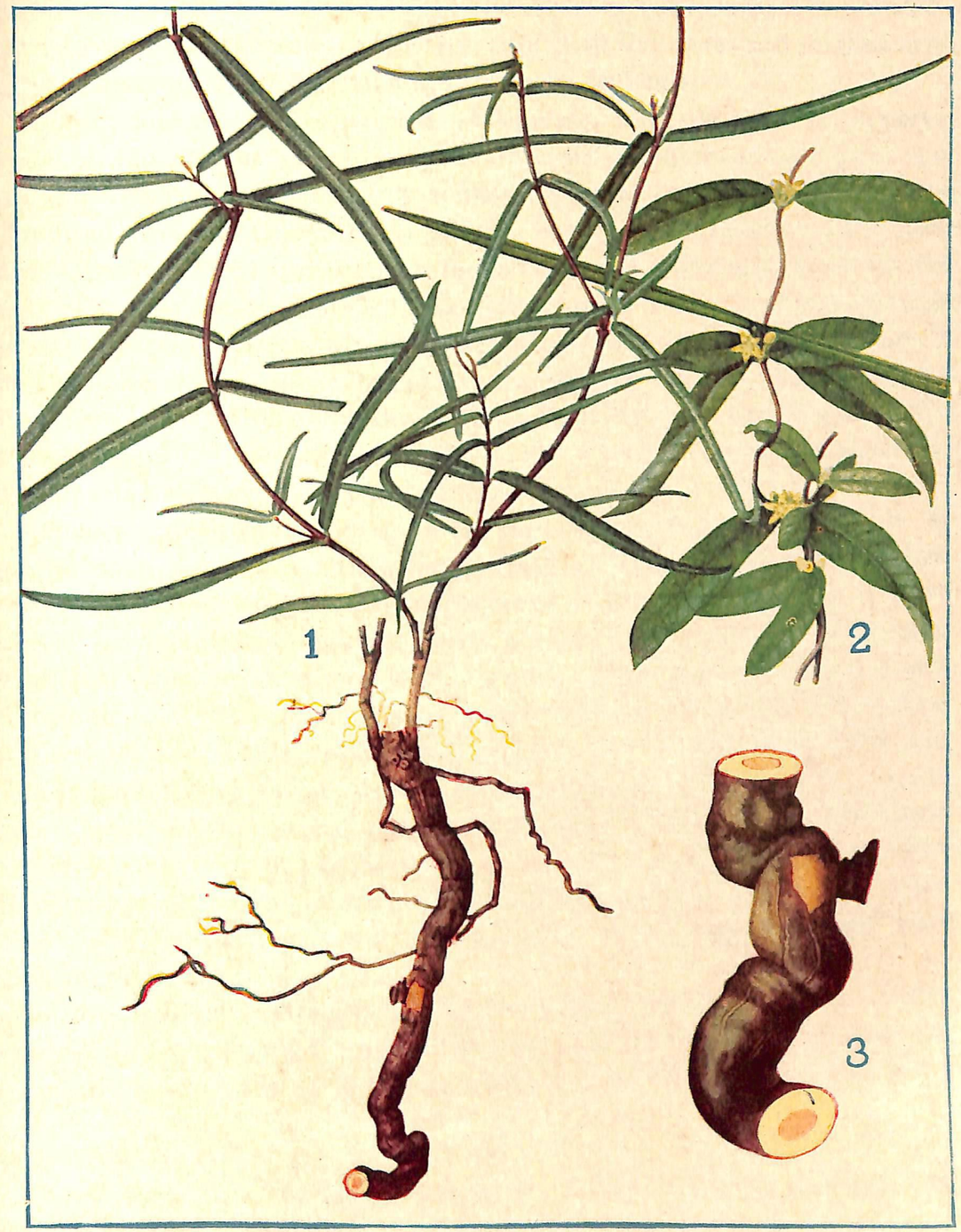
(Asclepiadaceae)

Tamil	...	Nan'n'ari
Malayalam	...	Nar'unanti
Hindi	...	Hindi-salsa
English	...	Indian Sarasaparilla

Distribution and habitat.

The plant is found throughout India growing under mesophytic to semi dry conditions in the plains and up to an altitude of 2000 feet. It is quite common in open scrub jungles, hedges, uncultivated soil etc.

Hemidesmus indicus R. Br. is a diffusely twining undershrub having numerous slender wiry laticiferous branches with purplish brown bark, bearing comparatively small, polymorphous, subsessile, opposite, ovate-elliptic to lanceolate or linear leaves, and axillary bunches of small yellowish to greenish purple flowers. The leaves in the basal portions of the plant are linear and dark bluish-green with a white streak along the midrib.



IV. Hemidesmus indicus, R. Br.

1. Basal portion of plant with tuberous root.
2. Flowering portion with fruit.
3. A small portion of root enlarged

External morphology

The stems and branches which twine anticlockwise are profusely laticiferous, elongate, narrow, terete and wiry, of a deep purple or purplish-brown colour with the surface slightly ridged at the nodes and marked with scattered distantly placed small slightly warty, lenticels.

Leaves: simple short petioled, exstipulate, opposite or in apparent whorls of four, leathery, entire, apiculate acute or obtuse, smooth shiny and dark green above, but paler and sometimes pubescent below. Their shape varies from linear or lanceolate to elliptic oblong or ovate, even in the same plant. Those of the basal parts of the shoots and prostrate branches are linear to lanceolate, two to six inches long, about a quarter of an inch wide and dark or deep green with a characteristic white streak along the mid-rib whereas those of the upper branches are shorter, broader; dull green and without any variegation along the midrib. Such leaves resemble those of the tip branches of *Ichnocarpus frutescens*, R. Br. which in Kerala is regarded as the alternate variety of the sariba pair.

Flowers: greenish-yellow to greenish-purple outside, dull yellow to light purplish inside, less than half an inch in diameter, borne crowded on short-stalked condensed axillary monochasial cymes and subtended by close series of persistent ovate-acute to lanceolate imbricating bracts. *calyx* deeply five-lobed; lobes ovate-acute with minute scales at inner base; *corolla* gamopetalous, about twice the calyx, greenish yellow outside and dull yellow to light purple inside rotate, five partite with a very short tube and ovate-oblong fleshy valvate lobes, each alternating with a thick corona scale: *Stamens* five, inserted near base of corolla with distinct filaments and small connate oblong anthers ending in inflexed appendages, the pollen masses cohering in pairs in each cell. *Pistil* bicarpellary, ovaries free, many ovuled with distinct styles which cohere at the top to form a flattened five-lobed stigmatic head.

Fruit: of two straight slender narrowly cylindrical widely divergent follicles-four to eight inches long and less than one quarter inch in thickness. Seeds many, flat oblong, with a long tuft of white silky hairs or coma.

Official part

The main root variously known as S'ariba, s'ariva, sugandhi etc is the part used in medicine.

Description of root

The roots are usually sold either in small bundles of cut bits six inches to one foot long or as compact bundles consisting of the entire root system of one or more plants wound up and tied with its own cord-like stem. The roots or very long and often reach a length of twelve feet or more, hence the term Ananta mūla, and from less than a quarter to about three quarters of an inch in thickness; nearly uniformly cylindrical, though in most cases they are irregularly bent, curved or slightly twisted; slightly woody, rigid and of a brownish or purplish brown colour often marbled with irregular patches of dull grey. Surface generally smooth in young roots, but in older and thicker roots it appears rough due to the formation of a few rows of vertically elongate warty, elliptical lenticels, and shallow vertical cracks which ultimately cause partial peeling off of the outer layers of the rind In fresh roots the rind is comparatively thick, (0.5 to 1mm) and crustaceous, easily separable, brownish or purplish brown outside and deep purplish on the inside, which appears minutely rugosepapillose. The rind has no characteristic taste or odour. The living tissues of the root within the rind shrink considerably on drying and get separated from the rind except along certain lines, while the rind itself being hard and crustaceous, does not shrink much but gets longitudinally folded, and often cracked vertically along the summits of the ridges. Short transverse cracks are also often formed.

The removal of the rind exposes the actual officinal part of the root which is about a third of the diameter in the smaller and medium sized roots. In fresh condition this tissue appears cream-white to cream-yellow, sometimes with a tinge of pale rose colour, but on exposure to air changes to dark brown. This darkening is normally confined to the peripheral portions. In the fresh condition this portion has an agreeable fragrance, and a warm aromatic sweetish taste both very characteristic of the drug. These features are not so markedly perceptable in dry roots. The central part of the root is formed of a strand of yellowish white woody tissue devoid of any smell or taste.

Fracture: Short at the periphery and fibrous at the centre.

Histology.

The transverse section of the fresh root is circular with a fairly regular outline. It shows a slightly compact porous strand of wood at the centre enveloped by a massive cream coloured starchy tissue and a peripheral strip of light reddish-brown rind.

The **cork tissue** appears light reddish-brown. It is composed of several rows of narrow rectangular tangentially elongate empty cells about six times as long as broad with thick reddish-brown to amber coloured walls, those of the peripheral layers being darker and thicker than those towards the centre. The innermost two or three rows are colourless and appear almost similar to the phellogen. Cut surfaces of one or two lenticels are also occasionally seen. These have widely divergent fan-shaped fringes enclosing a loose mass of thin-walled polygonal cells. The **phellogen** is composed of one to three rows of narrow thin-walled rectangular cells rich in protoplasmic contents. **phelloderm** is composed of four to eight or more rows of slightly thick-walled fairly large rectangular cells four to six times as long as broad and loaded with large sized starch grains. The *cortex* is a very broad zone (measuring nearly a fifth of the diameter in roots about a quarter of an inch in thickness) and is composed of several rows of very large thin walled tangentially elongate cells, those of the peripheral rows being narrower, tangentially elongate, and more regularly arranged without large intercellular spaces while those towards the centre are comparatively smaller, spherical oval or broadly oblong, and less regularly disposed with large intercellular spaces. Almost all of the cortical cells are fully loaded with large sized spherical, oval oblong or helmet shaped starch grains. The cortex forms the principal storage tissue and is remarkably free from mechanical elements of any sort.

Just within the cortex is a narrow annular strip of bast completely surrounding the wood. It consists of segments of phloem proper composed of three to five or more radial rows of normal thin-walled phloem elements alternating with uni-seriate medullary rays. The medullary ray cells are thin walled and slightly larger than those of the phloem parenhyma. No mechanical elements are found in the phloem. Latex tubes occur both in the cortex and phloem.

A narrow but distinct annular strip of cambium separates the wood from the bast. The wood is composed essentially of thick walled xylem parenchyma in which are found vessels of varying sizes, and a large number ofuni-seriate medullary rays. The medullary ray cells are smaller than the xylem parenchyma. They are narrow, oblong, radially elongate and rich in protoplasmic contents, but do not show inclusions of any sort. The cells of the xylem parenchyma are squre or rectangular, of rarely polygonal in outline and also devoid of inclusions of any kind. Vessel extend as far as the centre. Pith is absent.

Distinguishing features.

A. Morphological.

1. The roots are long, narrow, cylindrical, unbranched very often irregularly curved or bent, woody and of a rusty or purplish brown colour. Surface fairly smooth in fresh roots but longitudinally wrinkled and cracked in dry roots.

2. The outer bark or rind is fairly thick, hard, compact, crustaceous and easily separable in the fresh condition. Its inner surface is deep purplish and minutely pustular or papillose.

3. The officinal portion is comparatively thick, laticiferous, starchy or mealy and creamwhite when fresh but turns dark on exposure to air.

4. In the centre of the root is a narrow yellowish strand of wood.

5. Fracture short at the periphery, fibrous in the centre.

B. Anatomical.

1. The transverse section is circular, margin usually entire, (or slightly wavy in dry roots).

2. The cork tissue is composed of several rows of narrow rectangular empty cells with thick brownish or amber coloured walls.

3. The cortex is a broad zone formed of several rows of thinwalled cells most of which are fully loaded with large spherical to oblong starch grains.

4. The bast is a narrow annular zone consisting only of thin walled phloem elements and narrow medullary rays.

5. Latex tubes occur both in the cortex and phloem.

5 Mechanical elements are completely absent in the bark.

7. Wood consists of several vessels of varying lumen located amidst narrow radial bands of xylem parenchyma which alternate with narrow uni-seriate medullary rays.

8. There is no pith in the centre.

C *Taste and odour.*

The officinal part of the bark has a pecuiar odour and a warm aromatic taste both characteristic of the drug.

Mode of use and viability.

The medium sized roots are generally preferred for extraction of the drug. The bark which is obtained by removing the central woody core and the crustaceous outer rind, is alone used for medicinal purpose. The keeping quality of the root is very poor and so dried roots which are stored in bazaars are not always of good quality. It is said "the country sarasaparilla is far more energetic in its operation and salutary in its effects when freshly dug up than kept on hand for a long time when its fragrance is lost".

constituents.

The air dried material contains about 0.225% essential oil, of which about 80% consist of a crystalline substance, identified as 2-hydroxy-4-methoxy benzaldehyde. The odour of the drug is due to this aldehyde. The petrol ether extract of the roots of *Hemidesmus* contains a ketone (m—83°C) resinols, sterols and fatty acids. The alcohol extract of the defatted roots contains saponins, tannin, a crystalline resin acid (m—245°c) an amorphous resin acid (m-180°) and inosit l. The roots also contain small amounts of tetracyclic triterpene alcohols.

Greenish† states that the agreeable odour of the root is due to crystalline odourous substances resembling but not identical with coumarin.

Note. It is said to be "raktapittahara" i. e. antiscorbutic. Hence it is likely to contain vitamin C. The material is mostly used in skin diseases It is noteworthy that when the material is dried for powdering, the drying is always carried out in the shade and not directly in the sun.

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* Remarks on Bazaar medicines and common plants of India (1907) by E. J. Waring.

† Materia Medica 4th edition p. 350.

Hist logy of *Hemidesmus* and *Ichnocarpus* roots.

A *Hemidesmus* root.

Fig. 1. Details of peripheral portion of *Hemidesmus* root showing cork and secondary cortex.

2. Details of recent bast and wood in do.

3. Diagram of T. S. of *Hemidesmus* root.

4. Central part of the root in do. showing vessels.

5. A segment of the T. S. (diagramatic) enlarged.

B. Ichnocarpus root.

6 Transverse section of *Ichnocarpus* root.

7. Details of structure of wood and bast.

8. Diagramatic sketch of a segment of the T S. of root.

9. Details of peripheral region of root bark.

10 Details of the bast region.

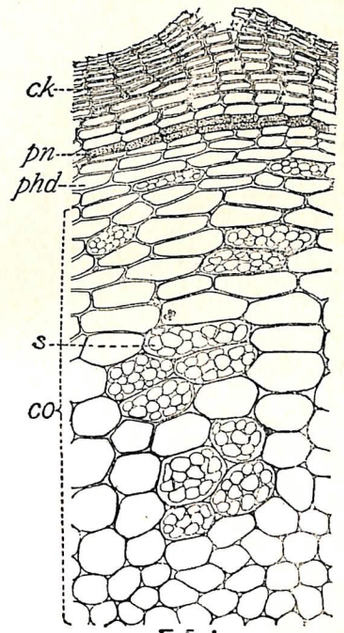

Fig. 1

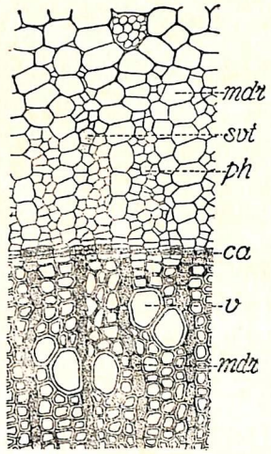

Fig. 2

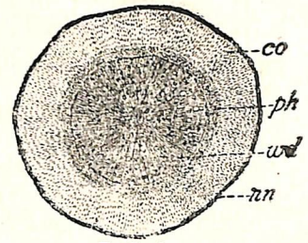

Fig. 3

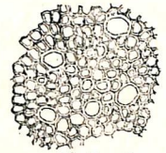
Fig. 4

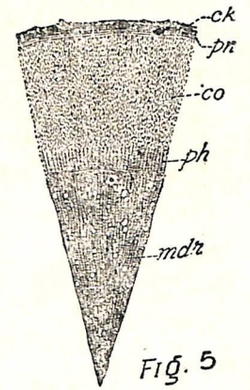

Fig. 5

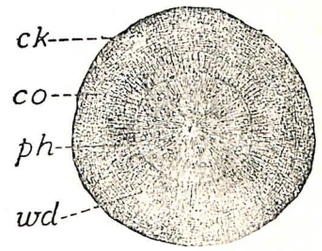

Fig. 6

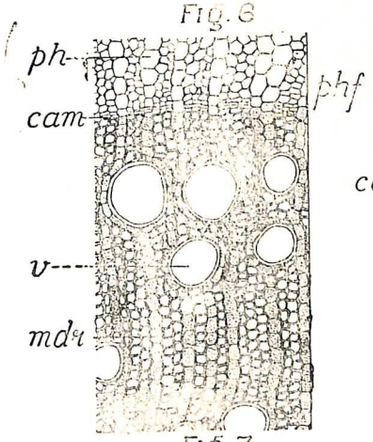

Fig. 7

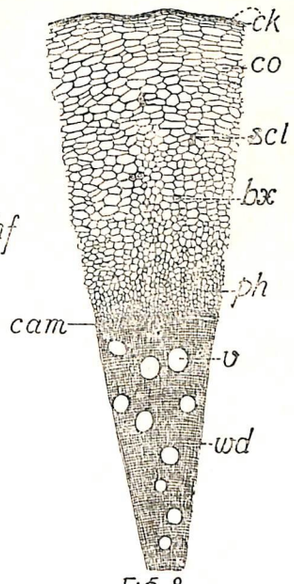

Fig 8

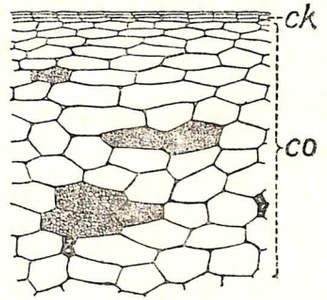

Fig. 9

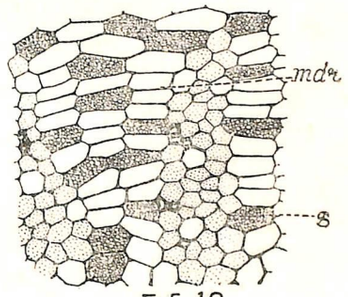

Fig. 10

V. Histology of *Hemidesmus* and *Ichnocarpus* roots.

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VI *Ichnocarpus frutescens*, R. Br.

Flowering twig and a portion of inflorescence.

ICHNOCARPUS FRUTESCENS, R. Br.*

(Apocynaceae).

Tamil	...	Par'avalli
Malayalam	...	Palvalli (Kar'utta narunanti,?
Hindi	...	Dudhi, Kalidudhi, Syamalata.

Distribution and habitat.

Distributed almost throughout India from Sirmore to Nepal, in the upper Gangetic plain from Delhi to Bengal, Assam, Sylhit and chittagong; the Deccan peninsula, South Maharatta country, Dharwar, Western Ghats and Travancore. It is found in various habitats from sea level to about 2000 feet commonly in the fringe of forests, river banks and open places.

Habit

Ichnocarpus frutescens R. Br. is a large extensively branched evergreen, woody twiner, with slender, terete, rusty brown finely tomentose laticiferous stem and branches, bearing short-stalked, simple, opposite leathery leaves of variable size and large terminal cymose panicles of small yellowish-white or light-purplish mildly scented flowers. The plant flowers principally during December to February or March, August and September

External morphology.

Leaves: simple, short-petioled, opposite, exstipulate, usually elliptic-oblong to broad lanceolate with rounded base and short acute tip, slightly thick and coriaceous when mature, somewhat glabrous above, pubescent and paler beneath with five to seven pairs of secondary nerves The size varies from one to four inches in length and one half to two inche in breadth. The tender leaves are covered with dense rusty brown pubescence. Petiole one quarter to half inch long in proportion to size of leaf.

Flowers: Small, numerous, pedicellate, borne in di-and trichotomously branched cymose panicles at the tips of branches. **Calyx:** small, tawny, divided at half length into five acute lobes. **Corolla:** regular five lobed

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* In Travancore *Ichnocarpus fruitescens* is regarded as the alternate variety of Sāribā (*Hemidesmus indicus*) and possessing identical properties. It is doubtful whether this plant can be considered as such, as it has none of the features of the former.

rotate, tube about one tenth of an inch long, much swollen in the middle and constricted towards the top, lobes slightly pubescent, about twice the length of the tube, with their bases broad and, narrow tapering and characteristically twisted deflexed distal ends. **Stamens** five, filaments, free short, inserted near the middle of the tube; anthers sagittate and slightly adhering to the stigma. **A disc** with five erect, narrow linear glandular segments is present outside the pistil. **Pistil** bicarpillary; ovaries distinct, finely hairy, shorter than the lobes of the disc, many ovuled, and with a short common style, obconic above and ending in a columnar stigma.

Fruit consists of two slender, cylindric, straight or slightly curved spreading or divaricate follicles, four to six inches long: seeds many, one half to three quarters of an inch long, linear, narrowed towards the tip and crowned with scanty or sparse deciduous coma of silky hairs.

Officinal part.

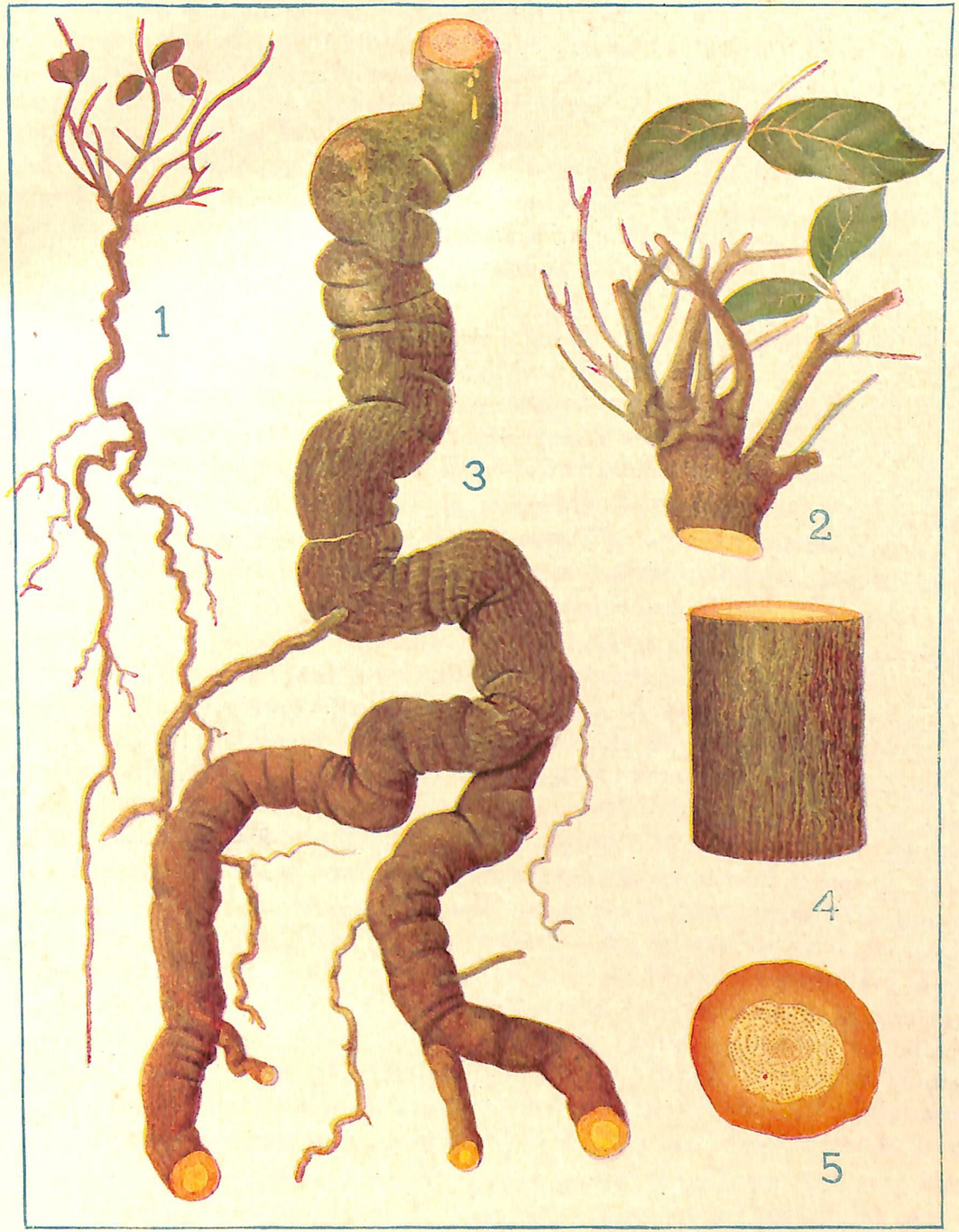
The main root is the officinal part. As already stated it is regarded as an alternative or substitute for S'ariba and is often used along with the latter. It is sold in the fresh or dry condition either as short cut pieces or entire.

Description

The root is considerably long, often irregularly bent and faintly constricted at the bends, unbranched or rarely with few branches, woody, cylindrical, from one half to about two inches in diameter, rusty or pinkish brown in colour with a fairly smooth surface devoid of prominent lenticels or exfoliating skin.

The fresh root is somewhat turgid and exudes plenty of creamy white or light yellowish latex when the surface is scratched or incised. It is covered with a thin soft skin which is easily scratched or scraped in the fresh roots, but, in dried roots it adheres firmly and the surface appears finely longitudinally wrinkled due to slight shrinkage. Short faint transverse cracks are also formed at the bends and at these points the root breaks easily.

The entire bark viz. the portion outside the wood can be easily separated from the wood by lightly hammering with a wooden mallet. It varies from less than a tenth of an inch to about one eighth of an inch or more in thickness in proportion to the thickness of the root. It is light purplish brown or rarely cream white, and in transverse section appears



VII. Ichnocarpus frutescens, R. Br.

2. Root and basal part of shoot. 2. Basal part enlarged.
3. Root showing general features.
4. Cut bit of root to show details of surface features. 5. Transverse section of root.

inely mottled with numerous darkpurplishor brow ishspecks andshort lines, which are more densely concentrated towards the wood. The peripheral part of the bark which has a homogeneous structure is starchy and of a deeper shade. On the other hand the inner part is paler or whitish, fibrous and slightly laminated. It is feebly sweetish, slightly astringent and somewhat gummy but devoid of any characteristic smell. The central strand of wood which froms the bulk of the root is of a dull white colour and appears highly porous in transverse sections. It is neither very hard or heavy and possesses no special taste or odour.

Histology

The transverse section is circular and its outline fairly regular. The *cork zone* is narrow and composed of five to ten rows of small narrowly rectangular tangentially elongate thin walled cells, the tangential walls of which are appreciably thicker than the radial walls. Some of the cells in the peripheral rows have dark purplish-brown contents which give a brownish tint to the cork zone. *Phellogen* is formed of one or two rows of somewhat similar but slightly larger, thin walled cells. The *cortex* or middle bark is a broader zone formed of several rows of thin walled oblong cells with very small intercellular spaces. These are two or three times larger than those of the cork and phellogen. The cells of the peripheral region are tangentially elongate, but those towards the phloem are broadly oblong to isodiametric. Most of the cells are loaded with starch grains of various sizes. A number of thin walled secretory cells of large and medium size with rosy or purplish brown contents several latex tubes which apper as small empty cavities, and a very limited number of sparsely scattered one to three or five celled groups of sclerenchyma are also present in this region. In young roots the cortex is comparatively broad but the cell appear almost devoid of starch. The demarcation between the middle and inner barks is not clear. The inner bark or *bast* is a distinctly broad annular zone formed of radial strips of phloem alternating with very narrow uni- or bi-seriate medullary rays In addition to the normal thin-walled phloem elements each strip of pholem carries several latex tubes and an extremely limited number of few celled groups of sclerenchyma. The pholem parenchyma cells are more orless isodiametric and smaller than the medullary ray cells. There are many medullary rays These are mostly narrow and uni-seriate, but occasionally two to five seriate rays also occur. Their cells are broadly rectangular or oblong and radially elongate in the xylem andbast but tangentially elongate inthe cortical region resulting in a fanwise broadeningout oftheir distal ends. *cambium*

is well defined and consists of two rows of cells. *Wood* is compact but resents a diffusely pitted appearance owing to the presence of a large number of scattered xylem vessels of various sizes. These vessels have profusely pitted walls and are surrounded by lignified thick walled cubical to broadly ectangular empty cells. In tangential sectiont he vessels appear to be provided with pitted transverse septa at regular but distant intervals The xylem parenchyma associated with the vessels are fairly long. The medullary rays of the wood are continuous with those of the phloem. Their cells which are larger than those of the xylem parenchyma, have thick pitted walls and are fully loaded with starch grains. There are two to five radial rows of xylem-parenchyma cells between successive medullary rays. The central part of the wood especially in older roots is formed of a tissue with thin lustrous walls This is a characteristic feature of this root.

Di tinguishing features.

A. Morphological.

1. The roots are long, woody, turgid, irregularly bent or curved of a rusty or purplish brown colour and with fairly smooth surface.

2. In fresh roots the surface skin is very thin soft and easily scrapable, but it adheres firmly in dry roots.

3. The bark has a pale rosy or flesh colour and is mottled with numerous minute purplish brown specks.

4. The wood which forms the greater part of the root is light md has a central pith like region in old roots.

B. Anatomical.

1. Transverse section nearly circular; outline regular or minutely wavy.

2. Cork consists of five to ten rows of small rectangular thin-walled cells, often with purplish or pinkish brown contents.

3. The fairly broad cortex is formed almost entirely of thin-walled parenchyma stored with starch.

4. Scattered in the cortical tissue there are several secretory cells with purplish or rosy contents, a limited number of two to five celled groups of sclerenchyma and latex tubes.

5. The bast is composed of thinwalled radial strips of phloem elements and alternating medullary rays. Latex tubes and an extremely limited number of few celled groups of sclerenchyma occur in the phloem as in the cortex.

6. There are numerous medullary rays, most of which are uniseriate and their cells are loaded with starch.

7. A tissue with thin lustrous walls forms the central part of the older roots.

C. Odour and Taste

The root bark is feebly sweetish, slightly astringent and gummy but neither the root bark or the wood has any perceptible smell.

Mode of use.

In most cases the entire root after cleaning or scraping the thin outer rind is crushed for extraction. Since there is no increase in the thickness of the officinal part corresponding to increase in the thickness of the entire root medium sized roots are preferable. In storage the roots remain viable for a few months only.

Chemical Constituents.

The active principle of the drug is a resin which amounts to 4.8% of the dry roots.

Comparison of Hemidesmus and Ichnocarpus roots

Hemidesmus	*Ichnocarpus*
The root is woody, long, slender variously curved or bent, slaty to purplish-brown, in colour, laticiferous when fresh and with very few stringy lateral roots and rootlets	The root is long, cylindrical, variously bent with shallow transverse constrictions, rusty or pinkish brown in colour and laticiferous when fresh. Lateral roots few or absent.
Surface slightly exfoliating and often cracked both longitudinally and transversely.	Surface fairly smooth, soft and non-ex-foliating. It appears finely longitudinally wrinkled in dry roots.

The outer bark or rind is thick hard crustaceous and easily separable from the rest of the root. Its inner surface is deep purplish and minutely papillose. The rind is composed of several rows of thick walled cork cells.

The officinal part is comparatively thick and starchy. It is cream white in fresh condition but changers to dull or dark brown colour on exposure. The cortical cells are large thin walled and richly laden with starch grains.

The inner bark or bast forms a narrow but well differentiated annular zone of thin-walled tissue Mechanical elements are not present in the cortex or bast.

The wood forms a central narrow strand It is cream white to light yellow and porous.

There is no pith.

Fracture short at periphery, fibrous towards the centre.

The officinal part has a characteristic smell and sweetish warm aromatic taste.

The surface skin is very thin soft and composed of a limited numbour of thin walled cells. It is easily scrapable but not peelable.

The bark is fairly thick, but thinner than in *Hemidesmus*. Its cut surface has a pale rose or pink colour especially towards the periphery with numerus minute dark purplish sports. The cortical cells are mostly loaded with starch. Several secretory cells latex tubes and traces of mechanical elements are also present.

The bast is clearly differentiated as an annular zone but it is slightly broader than in *Hemidesmus* and is composed mostly of thin walled elements.

Wood forms the bulk of the root. It is dull white or light yellow and appears diffusely porous in transverse section.

A pith like central part composed of thin walled cells is present in older roots.

Fracture similar to that of *Hemidesmus*.

The bark is feebly sweetish and slightly astringent, but possesses no characteristic smell.

YAṢṬIMADHU.

Malayāḷam	...	Ĕ-aṭṭimadhuram
Tamil	....	Aṭimaturam
Hindi	...	Mithilakdi, Muleṭhi
English	....	Liquorice

Source plants.

The plants yielding the drug are species of **Glycyrrhiza** particularly **G. glabra**, Linn. belonging to Papilionaceae.

Sanskrit texts.

Descriptive synonyms.

"Madhuyaṣṭī ca yasti ca yaṣṭīmadhu madhusravā
Yaṣṭikam madhukam ca iva yaṣṭyāhvam madhuyaṣṭikā"
(Dhanvantari nighantu)

"Yaṣṭimadhur' madhuyaṣṭi madhuvalli madhusravā
Madhūkam madhukā yaṣṭi yaṣṭyāhvam vasusammitam"
(Rājavallabha Nighantu)

"Yaṣṭimadhukam madhu ca klitanikā lakṣmaṇā ceti"
(Abhidhān'a man'jari)

"Yaṣṭimadhu tatha yaṣṭimadhukam klitakam tathā
Anyat klitan'akam tattu bhavetthoye madhūlikā"
(Bhāva pr'akāsa)

* Madhuvalli dvipr'akarā jalaja ca sthalodbhavā'
(Nighaṇṭu Ratnākara)

"Yasti" refers to its stick like appearance, "madhuka" to its sweet taste "madhuvalli" to its sweet weak stem and "laksmana" to some mark or some markings (?)

Ayurvedic properties and uses.

"Yaṣṭi" himā guruh svādvi cakṣuṣyā balavar'nakṛt
Susn'igdhā s'ukraḷā kes'yā svaryā pittānilāsr'ajit
Vr'aṇas'otha visa char'di tṛṣṇā glān'i ksayapāhā"
(Bhāva pr'akāsa)

* The Sanskrit texts mention another variety growing in water.

"Sāvrsyā madhurā rucyā balyā gur'vī ca sitalā
Caksusyā var'nadā svaryā sn'igdhā kesahitā m tī
S'ukr'alā raktapittaghn i vr'anasuddhikari matī
S'otham visam vātaraktam vr'anam vīntim trsīm tathā
Glān'im ksayam raktadosam rakt>pittam ca pittakam
Sadyovi'anam vātapittam nāsayediti kir'titam."

(Nighantu Ratnākaram)

It is cooling, heavy of digestion, sweet, good for the eye, improves bodily strength and complexion, is very demulcent, improves or stimulates production of semen, benefical for the hair, improves voice, overcomes vitiation of pitta (certain enzymes or enzymatic secretions which increase metabolic and other changes) of vata (corresponding to nervous and allied factors) and of blood, cures inflammation, cases of poisoning vomiting, thirst weakness, and wasting diseases. According to Nighanturatnakara it is also beneficial in ulcer, oedema, (sotham) combined pathological conditions of nervous and allied factors and of blood (vataraktam), haemorrhage resulting from mutual vitiation of pitta and of blood, and fresh wound (sadyovranam)

GLYCYRRHIZA GLABRA Linn.

Distribution

Warm temperate regions of Europe, Western and Central Asia and the Mediterranean Coast; especially in Russia, Germany, France, Spain, Italy Greece, Syria, Iraq, Turkistan, Persia Baluchistan, China and North Africa It is doubtful whether its distribution extends into India, though Yastimadhu has been an important item of the Indian pharmacopoeia. According to Sir Chopra, "indigenous liquorice is obtainable in the Peshawar valley and is met with in the sub-Himalayan tracts from the Chenab eastwards and grows throughout Burma and the Andaman islands." But there is no doubt that the genuine material was being imported even from very early times.

Glycyrrhiza glabra Linn. is an erect perennial shrub growing to a height of about four feet. Its principal or primary root does not generally grow deep but gives off a number of long tuberous secondary roots which may reach a length of four feet or more. The shoot system consists of an erect stem with a limited number of strong herbaceous branches which bear alternate odd pinnate leaves with five to seven pairs of ovate-oblong entire

VIII. Glycyrrhiza.

(N. G. C. Book Bank

pale greenish leaflets. It also produces a number of long slender somewhat succulent stoloniferous under-ground branches (rhizomes) which spread out in all directions and reach four to six feet in length.

The flowers are medium sized, sessile, purplish- blue, or pale violet and typically papilionaceous and the fruits are straight compressed or flattened oblong to linear echinate glandular pods one half to one and a half inches long, containing several kidney shaped seeds.

Cultivation and collection

Glycyrrhiza glabra grows best in warm temperate regions near streams where the soil is deep porous and fertile. It is propagated from cuttings of younger parts of rhizomes, as well as from suckers and seeds. These are planted in spring, about two feet apart in properly spaced rows. Under favourable conditions, in three to four years they develop rhizomes suitable for marketting. At the time of harvesting the ground is turned over to a depth of three or four feet and the rhizomes and roots are pulled out by hand. They are then thoroughly washed and spread out on floors of well ventilated rooms to dry until the pieces break with a snap. They are then cut into pieces of varying length and packed in bags for export.

Officinal parts.

The rhizomes and tuberous roots.

Description.

The drug as sold in the Indian bazaar is in the form of simple or rarely branched, dry, tough, woody and fibrous un-peeled cylindrical cut pieces mainly of the rhizomes, but pieces of roots are also occasionally found. The cut pieces are of a greyish-yellow, light purplish-brown, or rarely dull reddish-brown colour. The surface appears shrunken with closely arranged shallow irregular longitudinal ridges and furrows. Slight superficial cracks are also noticeable in most of the stouter pieces. Slightly raised short transverse ridges, one to two inches or more apart, are also noticeable in the rhizomes. These represent the nodes and in front of each of them there is a slight depression in which the small axillary buds are located.

The thinner pieces which evidently represent the tender portions of the rhizome are greyish-yellow to light brown and have a thin rind and a comparatively smooth non-lenticellate surface marked with faint longitudinal

ridges, whereas the thicker pieces are purplish to dull reddish-brown or dark brown and possess a thick woody rind the surface of which appears rough on account of fissures, exfoliation of the outer layers, and presence of a limited number of comparatively large slightly elevated spherical or oblong lenticels. The surface exposed after removing the rind has a non-shiny cream yellow or dull yellowish-brown colour, the depth of the colour varying according to the relative maturity of the pieces. In transverse sections a clearly demarkated brownish or dull yellowish-brown pith is present in the centre. This is surrounded by a slightly lighter or creamy yellow zone of wood, a fairly broad zone of bast and a very narrow cortex. In addition to these, several narrow whitish medullary rays are also visible. There is only very slight difference in colour between the wood, bast, and cortex and so demarkation between the regions is not always quite distinct. The outer bark is hard and crustaceous and firmly attached to the inner tissues. It forms a compact fairly thick woody rind varying from a hair's breadth to about one tenth of an inch in thickness according to the age and size of the rhizome and is made up of several thin layers, of which the outer ones are flaky dark grey or greyish brown and peel off successively while the inner layers are light to purplish-brown and have a firmer texture. In transverse section the entire rind appears as a faintly lamellated wavy or undulating brownish strip. It is devoid of any characteristic odour or taste. The middle and inner barks together form a fairly wide zone, occupying about a third of the diameter of the pieces In the bast proper, several close set radiating rows of small dark shiny spots can be made out. These often appear in pairs and alternate with radiating strips of lighter coloured tissue.

The wood is light yellowish and is marked with fine closely arranged concentric striations. Its thickness varies in direct proportion to the age and thickness of the piece. On light thrashing or crushing it easily breaks up into fibrous flakes. Several uniformly narrow, closely spaced greyish white medullary rays extend from the pith to the periphery. Their number structure and appearance form a characteristic feature of the cut surface.

The pieces break easily with fracture which is fibrous in the bark and splintery in the wood. The drug has a characteristic odour and a feebly nauseating sweetish taste. It is slightly bitter in some cases. The bitter taste is less marked in pieces of mature rhizomes but more marked in pieces of tender rhizomes.

Histology.

The *rind* is composed of several rows of narrow rectangular, tangentially elongate empty cells. Those of the outer rows are usually much compressed and have thick dark brown walls but the inner cells are arranged in regular rows and have comparatively thin light reddish or purplish-brown walls. The *phellogen* or cork-cambium is generally found in a collapsed condition. The *cortex* is a comparatively narrow zone formed of a limited number or rows of oblong cells. The *bast* or phloem forms a broad and prominent zone especially in the stouter pieces. It is composed of a large number of narrow radial segments of phloem alternating with bands of medullary rays. Each strip or segment of phloem is wedge shaped. Its broader end is nearest the wood and it tapers almost to a point in the cortex Almost regularly spaced distinct groups of bast fibres are also present in addition to the usual thin walled phloem elements. The older phloem elements situated towards the outside are in most cases in a collapsed or disorganised condition and appear as patches of irregular reticulated structure with lustrous lamellated walls and linear (tangential) meshes of varying sizes. The medullary rays are almost uniform in size. Their cells are thin walled rectangular or sometimes polygonal in outline, slightly larger than the phloem parenchyma cells, and fully loaded with starch grains of various sizes. The cells in the xylem part are radially elongate, but towards the distal end they are tangentially elongate, the transition being gradual. The *cambium* is a narrow but distinct annular trip. The *wood* is a wide zone composed of a very large number of narrow radial strips or bands of xylem alternating with narrow medullary rays. The vessels are of various sizes and have thick pitted walls. The cavities of some of them are blocked with tyloses. The xylem parenchyma cells are rectangular or polygonal thin walled and fully loaded with starch grains. Regularly arranged groups of thick walled wood fibres similar to those of the bast occur here also. In transverse sections they appear as closely arranged narrow, concentric, annular strips of dark tissue alternating with lighter coloured rings of xylem parenchyma. The pith consists of fairly thick walled parenchymatous cells, often containing starch grains.

Distinguishing features of pieces of rhizome.

A. Morphological.

1. The cut bits are dull yellowish or purplish-brown to dark brown simple, or rarely branched, and woody, with a longitudinally wrinkled surface

2. The outer bark or rind is fairly thick, somewhat woody, hard crustaceous and shrunken. It adheres firmly to the inner part and, appears as a thin brownish strip in transverse section.

3. The cut surface, excluding the rind, has a more or less uniform light yellow colour, and a non-shiny appearance.

4. The wood is cream white to light yellow, and is marked with fine closely arranged concentric striations. The bast and cortex are of a deeper yellow, and radially arranged small dark brown spots can be made out in the former.

Towards the centre of the wood is distinct pith of a dark or pull yellow colour.

5. Peripheral fracture fibrous that of the wood splintery

B. Anatomical.

1. The transverse section is circular with wavy or undulating margin.

2. The rind is composed of several rows of narrow tangentially elongate empty cells, with fairly thick brownish walls.

3. The cortex is a very narrow zone.

4. The bast is fairly wide and composed of radial strips of phloem alternating with medullary rays. Groups of bast fibres arranged in regularly spaced radial rows are present in each strip of phloem. Medullary ray cells are loaded with starch grains.

5. Wood shows narrow medullary rays continuous with those of the phloem and alternating with strips of xylem. The latter is composed of vessels of various sizes, compact groups of sclerenchyma similar to those of the phloem but appearing as closely arranged concentric lines, and thin walled storage parenchyma alternating with the fibre masses.

6. The cells of the pith are fairly thick walled and often contain starch grains.

C. *Odour and Taste*

The wood and bast portions possess a sweetish taste and a characteristic odour.

Mode of use and keeping quality.

The material after removal of the rind is powdered for extraction. On account of its sweetness it is susceptible to insect attack. So if it is not

stored carefully it gets infested by insect larvae which tunnel into it. It is therefore best to store it in airtight containers after dry sterilisation at 80°C.

Constituents.

The drug contains glycyrrhizin 6-7% starch 27·4% and ash 6·3% Total extractives: petrol ether 1.3%, ether 4.3% alcohol 21·7 %, chloroform 4.5% and water 24.2%.

The ash contains iron, manganese, calcium and sodium Glycyrrhizin is a glucoside consisting of the calcium and potassium salts of glycyrrhizic acid. The acid is a colourless crystallines substance melting at 205°C. It imparts a sweet taste to water even at a dilution of 1 in 20,000. On hydrolysis, the acid yields glycyrrhetinic acid and glycuronic acid. Associated with glycyrrhizin is a flavanone glycoside liquiritin (melting point 212°C) which on hydrolysis gives d-glucose and liquiritigenin (melting point 207°C) In addition to these glycosides, the drug also contains small proportions of dextrose, sucrose, proteins, fat resin and asparagin (about 1%)

C. Book Bo

GUÑJĀ

Source plant

Abrus Precatorius, Linn belonging to Leguminosae (Papilionaceae)

Sanskrit Texts.

Descriptive Synonyms.

"Guñjā cūḍāmaṇī raktaphalikā kākaṇantikā
Kākādanī kākaciñcī kṛṣṇalā kṛṣṇaraktikā"

(Sāligrama nighaṇṭu)

"Śvetāguñjoccatā proktā kṛṣṇatā cāpi sā smṛtā
Raktā sā kākaciñcī syātkākaṇantī ca raktikā
Kākādanī kākapīluḥ sā smṛtā Kākavallarī"

(Bhava prakas'a)

'Raktaphalikā' refers to the red seeds and **'Krsnaraktikā'** to the red seed with black hilum.

Properties and Uses.

"Guñjā dvayam tu kesyam syād vāta pitta jvarāpaham
Mukhasosa bhramas' vāsa trsnā mada vinās'n' am
Netrāmayaharam vrsyam balyam kandū vr'anam haret
Krmīs' ndralupta- kusthān'i raktāpi dhavalāpi ca"

(Bhāva pr'akās'a)

"Guñjā rūksī tathā tiktā viryosnā ca prakīrtitā
Visvaisamya jantughnī rogagrāmabhayapahā"

(Dhan' van' tari nighaṇṭu)

Both red and white types are beneficial for the hair. cures diseases due to vitiation of vāta and pitta, fever, dryness of mouth, giddiness difficult breathing, thirst, excitement, diseases of the eye, improves sex-vigour and bodily strength, and is beneficial or useful in pruritus ulcer, destruction of worms and similar parasites, alopecia and skin diseases

According to Dhan' van' tari nighaṇṭu it is rūkṣa i. e. causes dryness and roughness as opposed to sliminess, and is a bitter. It is thermogenic,

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is useful in poisons and is a paraciticide besides being useful in a host of diseases.

The drug seems to have been in use in Hindu medicine from very early times being mentioned by Suśruta and other early Sanskrit writers, who describe two varieties–the red and white, both considered as of equal efficacy.

"raktāpi dhavaḷāpi ca" and "guñjā dvayam tu keśyam" (Bhāvaprakaśa).

ABRUS PRECATORIUS, Linn.

(Leguminosae)

Maḷāyaḷam	...	Kunni
Tamil	....	Kuntumani
Hindi	...	Ratti
English	....	Wild liquorice; Indian liquorice; Jecquirity.

Distribution and habitat.

A common wild plant found throughout tropical India and other warm countries from sea level up to 3000 feet under mesophytic conditions: seldom cultivated.

Abrus precatorius, Linn. is a hardy much branched dense foliaged diffuse, perennial twining shrub with flexible cordlike woody stem and strong tough wiry branches bearing paripinnate compound leaves which are somewhat sweetish. Blooms usually in the beginning of the cold season or towards the end of the rainy season.

External morphology

Stem: woody, twining, upto about one inch in thickness and reaching a length of thirty feet or more; branches, slender wiry and flexible 0·1 to 0·2 inch in diameter.

Leaves: two to four inches long, alternate, stipulate, abruptly pinnate, with eight to twenty pairs of leaflets. Leaflets opposite, subsessile, membraneous, glabrous, oblong, symmetrical, obtuse at both ends, three eighth to three quarters of an inch long and one sixth to two thirds of an inch broad, the successive pairs slightly increasing in size from the base to tip of rachis : stipules and stipels minute and deciduous.

Abrus precatorius, Linn.

1. Flowering twig. 2. Part of inflorescence. 3. Fruits.

Flowers: small, shortstalked with minute deciduous bracts and bractioles, crowded in fascicles of six to ten flowers on ovoid tubercular swellings developed along one side on the distal halves of short leaf bearing axillary racemose peduncles two to four inches long: *calyx-tube* small compat nulate with short teeth; *corolla* papilionaceous, excerted; *stamens* nine, monadelphous, the vexillary one absent, anthers uniform. *Ovary* subsessile, many ovuled with short incurved style and capitate stigma.

Fruit: A more or less turgid, oblong, dehiscent pod with brownish pericarp, one third to half inch wide and nearly two inches long and containing three to eight shining hard coated seeds, which are attractively coloured bright scarlet with a black area near the hilum.

Three varieties of *Abrus* are met with viz., (i) the common type with scarlet coloured seeds having black area near hilum, (ii) a completely white seeded variety which is less common but occasionally cultivated and (iii) a black seeded type which is very rare. There does not seem to be any noteworthy difference in appearance and structure of the roots of these three varieties. In Kerala, the white seeded variety is usually preferred on the assumption that it is more potent, particularly in the treatment of snake poison.*

Officinal parts.

The roots, leaves and seeds are used for medicinal purposes.

Description of the root.

The main root does not usually grow deep into the ground but gives off a number of fairly stout, nearly horizontally growing side-roots a short distance below the ground level. These are usually long irregularly curved woody hard and range from a quarter to half an inch in thickness. The roots are usually sold as cut pieces of varying lengths or occasionally as compact bundles consisting of the entire root systems of one or more plants.

The roots are simple or branched, cylindrical, most often irregularly curved and of a light brown or light reddish brown colour. The surface of the root is profusely warty and somewhat rough on account of the eruptive development of numerous small lenticels. The entire bark is comparatively

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* [Mhaskar and Cais in Indian Medicinal plants by Kirtikar and Basu second edition, vol I, page 736, however state that "the root applied externally and the leaves given internally are useless in the treatment of snake-bite"]

thin comprising only about an eighth of the thickness of the root. The outer skin is thin, slightly corky soft, easily scrapable and exfoliates in small irregular thin flakes. When the skin is removed the living bark which is the officinal part is exposed. This is cream coloured or yellowish-white externally and light yellow within. It has a leathery fibrous texture, a feebly sweetish and strongly astringent taste with a somewhat disagreeable odour which is very pronounced in roots which have been in storage for sometime. The degree of sweetness and astringency varies consi lerably in roots from different plants, probably depending on the nature, of the soil and the season of collection. It may also be noted that the thickness of the officinal bark does not increase in proportion to the thickness of the root. The wood forms the most prominent part of the root. It is hard and heavy, has a light yellowish or cream colour, and is devoid of any characteristic taste or smell. In transverse section, the cut surface of the wood is smooth and shiny and nearly circular in outline occasionally with a few fairly deep conical recessions.

Histology of the root:

The *cork-zone* which is a thin layer is comosed of three to five or more rows of very narrow tangentially extended cells with thin brownish walls and having brownish contents in some cases. The *phellogen* is formed of one or two rows of cells but is not always quite distinct Next within is a narrow zone of secondary cortex consisting of four to six rows of regularly arranged comparatively large thin-walled rectangular slightly tangentially extended cells, most of which are rich in protoplasmic contents but devoid of other inclusions. Within this and forming the outer boundary of the bast is a narrow but prominent, annular ring of sclereids composed of two to four rows of spherical, ovoid or slightly elongate stone cells with thick pitted walls. Closely adhering to both the inner and outer margins of this ring and spaced at short intervals are small groups of sclerenchyma composed of four to ten thick-walled cells which are smaller than the stone cells. Their presence especially on the inner margin give an irregular wavy appearance to the ring.

The *inner bark* formed of the secondary phloem and medullary rays forms the most prominent part of the root-bark comprising nearly 90% of its thickness. The medullary rays which extend as far as the layer of stone cells are narrow towards the inner side but gradually widen as they approach the periphery where they terminate as diverging or funnel-shaped structures. The cells of the medullary rays are thin-walled and

rectangular They are radially elongate in the xylem part of the medullary ray as well as in the bast region just outside the xylem but tangentially elongate towards the distal end of the ray. Most of the cells are fully loaded with starch grains of various sizes. Alternating regularly with the medullary rays are narrow radial bands of phloem composed mostly of thin walled elements. Small groups of sclerenchyma, similar to those adjoining the ring of stone cells, occur here also. These are located on each side of the phloem elements close to the medullary rays in discontinuous radial series and extend as far as the ring of stone cells.* The older elements of phloem are usually found in a compressed disorganised or deliquesced condition forming obliquely and tangentially arranged irregular patches. These patches are of various sizes and shapes and often have a reticulated appearance with linear meshes and lustrous lamellated walls. The *cambium* forms a complete ring outside the wood and consists of one or two rows of very narrow cells. The *wood* is composed of narrow concentric annular bands of very thick-walled wood fibres or sclerenchyma alternating with similar but wider zones of thickwalled parenchyma in which are located vessels of varyiny sizes with thick pitted walls. Each annular band of wood fibres is composed of a number of short segments, separated by the medullary rays. Several medullary rays radiate from the centre of the wood. The majority of them are narrow and uni-or bi-seriate. In addition a few broader rays composed of five to ten or more rows of cells may also be occasionally present. These have some what diverging narrowly deltoid distal ends in the xylem or wood into which wedges of phloem protrude The parenchyma cells of the wood and bast are also packed with starch grains of various sizes.

Distinguishing features.

Morphological:

1. The roots are woody, cylindrical, variously curved light brown to reddish-brown and with a profusely and minutly lenticellate warty surface.

2. The skin or outer rind is thin or membraneous, slightly corky, soft, peelable and exfoliates in very thin narrow irregular flakes

3. The officinal bark, though comparatively thin, is tough or leathery and cream white to very light yellow.

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*(These fibre groups are neither so prominent nor regularly arranged as in *Glycyrrhiza*.)

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4. The wood which forms the bulk of the root is yellowish and its cut surface is hard and shiny.

5. Fracture of the wood is short.

Anatomical:

1. Transverse section of the root is nearly circular.

2. The cork zone is very narrow and is composed of a limited number of rows of narrow rectangular tangentially elongate empty cells with thin light brown walls.

3. There is a narrow phelloderm of six to ten rows of rectangular thin walled cells without inclusions.

4. Within this is a narrow but prominent annular somewhat irregular ring composed of two to four rows of large sized stone cells with small groups of sclerenchyma located at short intervals in close contact with its outer and inner margins.

5. The inner bark is the widest part of the bark and is composed of radial segments of secondary bast alternating with narrow medullary rays. Somewhat lustrous narrow irregular reticulated patches of compressed and collapsed bast elements are found throughout the bast. In addition small groups of the sclerenchyma similar to those associated with the ring of stone cells, are also found adjacent to the medullary rays.

6. Most of the medullary rays are uni-and bi-seriate; a few broader rays composed of four to ten or more rows are also occasionally present. All the cells of the medullary rays are thin-walled and fully packed with starch grains.

7. The wood consists of concentric annular strips of wood fibres alternating with broader and lighter coloured zones of parenchyma, and hence appears concentrically striated in transverse section.

8. There is no pith in the centre.

Odour and Taste.

The officinal part of the bark has a feebly sweetish and a pronounced astringent taste. The entire root emits a disagreeable odour when stored.

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Fig. 1

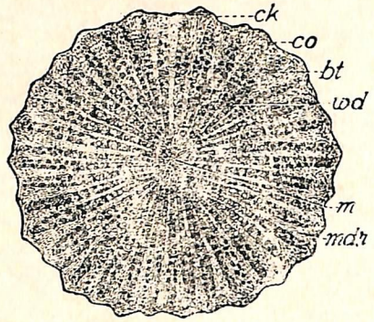

Fig. 2

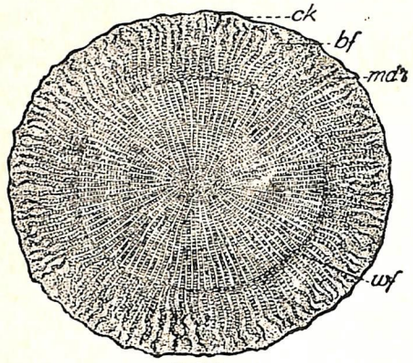

Fig. 3

Fig. 4

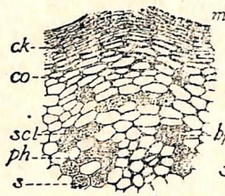

Fig. 5

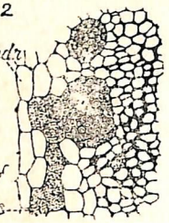

Fig. 6

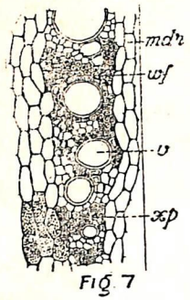

Fig. 7

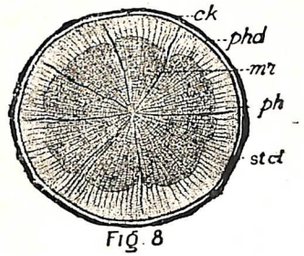

Fig. 8

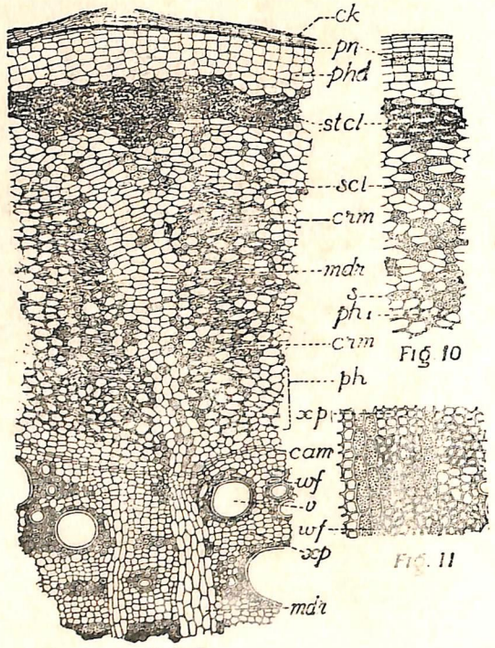

Fig. 9

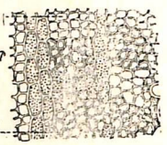

Fig. 10

Fig. 11

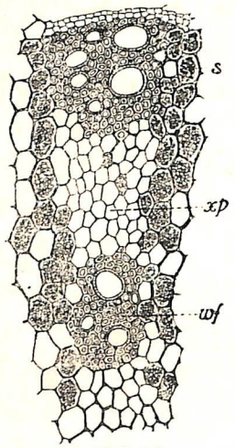

Fig 12

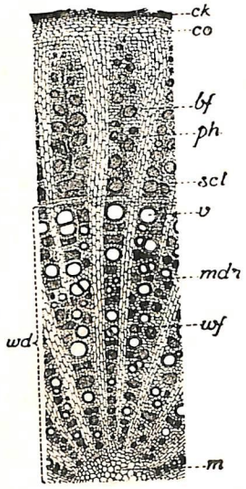

Fig. 13

X. Histology of *Glycyrrhiza* rhizome and *Abrus* root.

Mode of use.

Though the living bark alone is considered officinal, in practice the entire root is crushed and used. For medicinal use the thinner roots which have proportionately less wood way be prefarred.

Chemical composition.

The dried roots of the red-seeded variety contain alkaloid 0·05%, starch 8.9% and ash 6·1% Total extractives petrol ether 2·1% ether 2.3% alcohol 12·5%, chloroform 3·1%, acetone 6·4%, and water 10·2%.

The dried roots of the white-seeded variety contain alkaloid 0·07% starch 9·7% and ash 5·9%. Total extractives petrol ether 3·3%, ether 2·5%, alcohol 13·2%, chloroform 2·9% acetone 5·8% and water 8·5%

Both the varieties contain the same alkaloid Abrine, which is not to be confused with Abrin, the toxic albuminoid product isolated from the seeds of *Abrus precatorius*, (Jequirity seeds). The ash of both varieties contain iron, manganese, calcium, sodium and potassium.

Histology of *Glycyrrhiza* rhizome and *Abrus* root.

A. Glycyrrhiza rhizome.

Fig. 1. Cut bit of *Glycyrrhiza*
" 2. Transverse section of young rhizome.
" 3. Transverse section of older rhizome.
" 5. Portion of *Glycyrrhiza*.) rhizome showing cork and adjacent tissues.
" 6. Portion of bast showing fibre groups, medullary rays and phloem.
" 7. Portion of xylem and adjacent medullary rays.
" 12 Portion of xylem strip showing vessels, fibre groups, wood-parenchyma and medullary rays.
" 13 A semidiagramatic sketch of a segment of the T.S. of *Glycyrrhiza* rhizome.

B Abrus root.

" 4. Cut bit of *Abrus* root.
" 8. Transverse section of *Abrus* root.
" 9, 10, 11 } Portions of T.S. of *Abrus* root showing details of structure.

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